

## Little Valley Wash and the Upper Valley Field: Recent and Historic Oil Spills at Grand Staircase-Escalante National Monument



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NATIONAL  
CONSERVATION  
LANDS



# **Little Valley Wash: Recent and Historic Oil Spills**

## **A Report to the Utah Bureau of Land Management**

**Prepared by BLM-Utah with assistance from Grand Staircase-Escalante National Monument, Green River District, and BLM-Utah, Monticello Field Office**

### **Executive Summary**

On March 22, 2014 hikers reported oil deposits in Little Valley Wash, southwest of Escalante, Utah, on the Grand Staircase-Escalante National Monument (GSENM) to BLM Law Enforcement Officer Jeff Lauersdorf. Map 1 shows Little Valley Wash and the Upper Valley Unit in regional context. Subsequent field investigations by LEO Lauersdorf, GSENM resources staff, and NorthWind (an environmental consulting firm contracted by BLM) determined that there is no current, active leak, and that the hikers encountered oily deposits that originate from several distinct spill events. The most recent occurred last winter; two other events are decades old. The location of identified oil deposits is approximately 54 miles upstream of the Escalante River and the spill materials appear to pose no threat to the river and associated natural resources.

The events that have contributed to the oily residues and asphalt-like deposits in Little Valley Wash are related to spills or releases of oil and associated produced water from Well #27 and an associated pipeline. The two decades-old spills have left a considerable volume of weathered oil residue in the drainage; we estimate that volume at some 550 barrels of oil. One of these spills originated at the well itself, and may have occurred during drilling in 1971. The other older spill is associated with the same pipeline that was repaired last winter; the spill is somewhat younger in age than the spill from the well, but is also probably decades old.

The most recent spill occurred in December, 2013. Citation Oil & Gas Corp., the current operator of the field, repaired the pipeline leak which was responsible for this spill; the operator estimated the spill as less than 10 barrels of material, below the Bureau of Land Management's reportable quantity threshold for major undesirable events. The path which these spill materials followed appears to have been affected by snow and ice on the ground; much smaller in volume than the earlier spills, it left oil-saturated sediments near the pipeline and oil-splashed plants down the steep canyon walls at the head of the drainage. Only a small quantity of oil from this leak is present down in the drainage itself. Map 2 shows the spatial relationship of the two older spills and the recent leak as reconstructed from the GSENM investigations.

At present, the most lasting impact of these spills appears to be to the remote, scenic, and unspoiled natural quality of this portion of the Grand Staircase-Escalante National Monument. BLM will continue to monitor natural resource conditions in Little Valley Wash, with particular attention to the quality of water flowing from seeps and the health of the native vegetation. A chemical analysis of water flowing over the older, asphalt-like deposits in the drainage show that the sample is well within Utah's surface

water quality standards, and, although it is still early in the growing season, the vegetation in the drainage shows no apparent ill effects. Chemical analyses of oil-saturated soils from Little Valley Wash indicate that the lighter hydrocarbon fraction of the crude oil released into the wash is nearly completely depleted, and the material poses no significant threat to natural resources.

The oil residues seen on living plants in the drainage will continue to weather and exfoliate, and the plants should suffer no long-term impacts. The thicker deposits on the drainage floor are susceptible to erosion during flash-flood events, however, and as the deposits are exposed, as they appear to have been following the scouring flash floods of September, 2013, oily residues may be remobilized and moved down the drainage. Small tar “balls” which are scattered the length of the drainage are probably being created and moved downstream during such flood events. Stepped up, continued monitoring by BLM staff will reveal any long-term damage to natural resources, including wildlife, which may occur as a result of the spills.

Clean up and remediation options are limited by the difficulty of access to the most affected stretches of Little Valley Wash, which is narrow, boulder-choked, and largely inaccessible to heavy motorized equipment. Available options include leaving the oil deposits in place and relying on continued exposure to sunlight and air to break down the hydrocarbons and biodegrade the materials; mechanical or hand removal of the oil-saturated soils; and the development of catchment and containment systems to keep oil-affected soils and remobilized liquids from moving further down drainage. At present, remediation in place through biodegradation and a robust monitoring program, appears to be the best option.

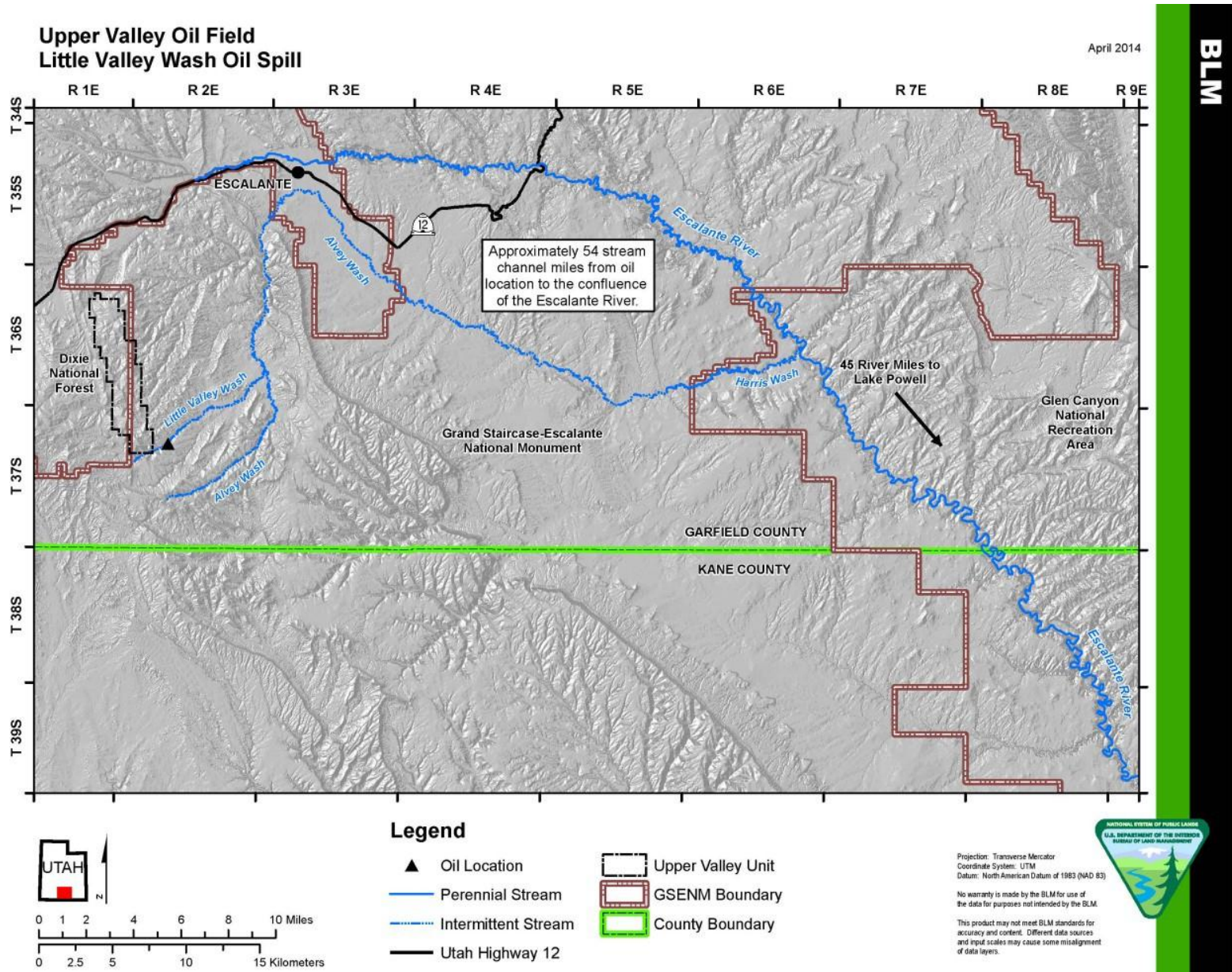
BLM will work with Citation Oil & Gas Corp. to conduct a thorough assessment of the Upper Valley Field infrastructure, including pipelines, monitoring equipment, and other equipment which may fail and lead to a spill event. BLM has already put Citation Oil & Gas Corp. on notice to report any spill, of any volume, that may occur in the Upper Valley field. BLM will also work with Citation Oil & Gas Corp. to prepare and implement a new surface use plan for the field. This plan will be developed in consultation with U.S. Forest Service, Dixie National Forest field administrators and BLM, and will include updated monitoring requirements and remediation options and treatments that recognize and take into account the management goals for GSENM and the Monument Management Plan. As part of this surface use plan, BLM will work with Citation Oil & Gas Corp. to develop a contingency plan for future remediation and clean up options.

The BLM and GSENM will continue to monitor natural resource conditions in Little Valley Wash, with particular attention to the quality of water flowing from seeps and to the health of the native vegetation to determine if there is any long-term damage to natural resources. The BLM and GSENM have also instituted a resource monitoring program targeting the drainages that lead from the Upper Valley Field onto the national monument. We plan to provide cross-training in oil field monitoring for our back-country rangers and other resource specialists.

The body of this report includes additional background information on the Upper Valley Field, Well #27, and Little Valley Wash; initial incident reports; BLM's initial response; coordination with Environmental Protection Agency, US Army Corps of Engineers, State and other Federal agencies; analyses of spill material; observations volunteered by former BLM employees who worked in the vicinity of Little Valley Wash and the Upper Valley Unit; a summary of field observations and records research; and BLM's plans for monitoring and remediation. Details of the chemical analyses and field studies conducted under the direction of the BLM and Citation Oil & Gas Corp. are included as Appendix A. Appendix B includes the production inspection report prepared by Jeff Brown, BLM Petroleum Engineering Technician and Tyler Cox, Natural Resources Specialist. Field reports by GSENM resource staff are included as Appendix C. Dr. Alan Titus' event reconstruction field report is included as Appendix D, and Undesirable Event Logs from BLM and USFS are included as Appendix E.

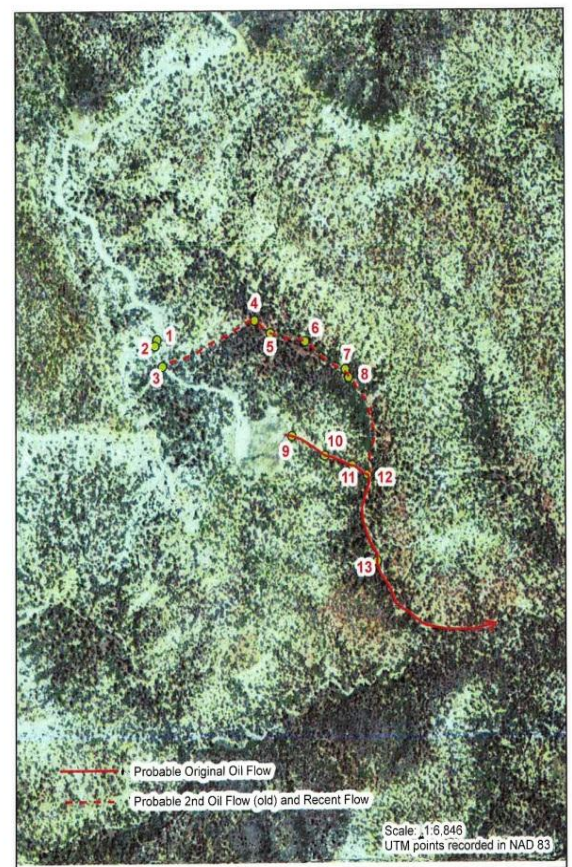
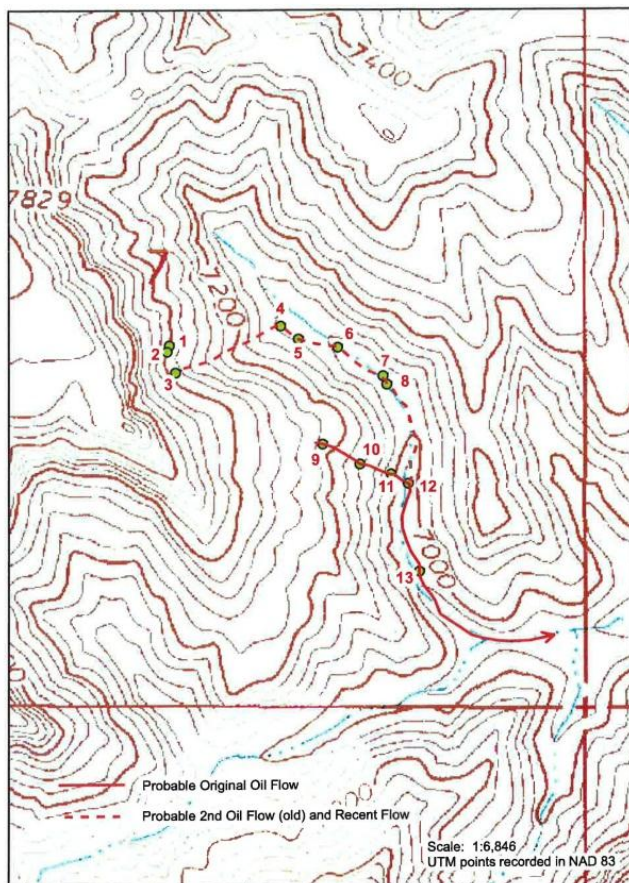


**Map 1. Overview of spill location.** Note that Little Valley Wash, Alvey Wash, and Harris Wash are intermittent streams. The Escalante River is the only perennial stream in this watershed. The oil deposits in Little Valley Wash are approximately 54 stream miles from the Escalante River.



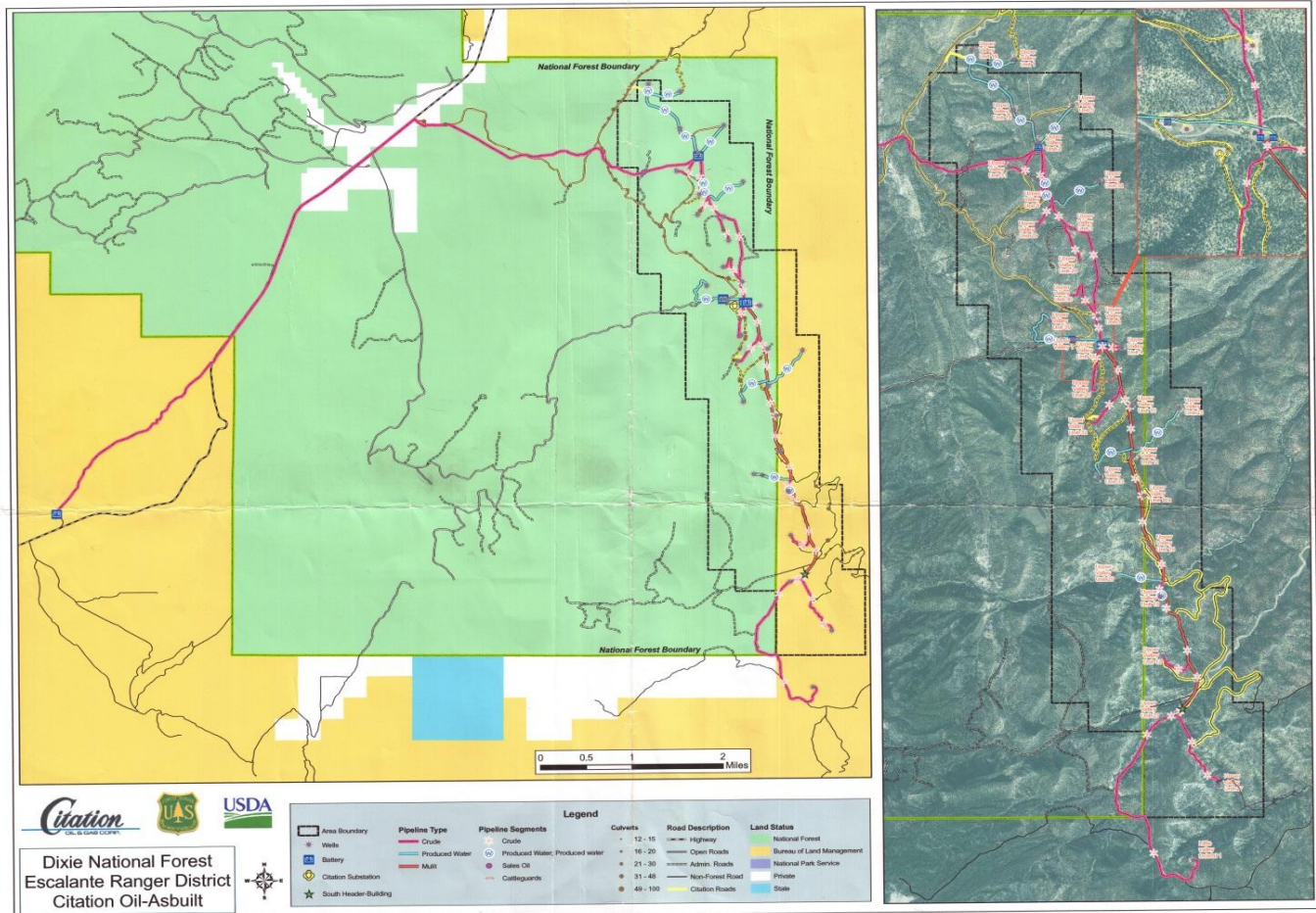


**Map 2. Detail of points of origin of three mapped spill events, topographic detail on left, and aerial photograph on right.** These detail maps show approximately the first mile of Little Valley Wash drainage. The solid line indicates the route of the oldest spill event, which originated from the well site itself, probably during initial drilling in 1971. This spill left stains on rocks down the east slope below the well head and left asphalt-like deposits in the drainage bottom. Well #27 is immediately west of the point labelled 9 at the west end of the solid line; the well pad is visible in the aerial photograph on the right. The well spill continues down Little Valley Wash in the direction of the arrow. The dashed line indicates the path of two events associated with the Well #27 pipeline. The material from the December, 2013 event and the older, larger flow followed the same path down the cliff and into the Little Valley Wash drainage. The spatter from the December, 2013 event did not extend past the confluence of the two older spills. The older spill material is evident as thick, asphalt-like deposits extending down Little Valley Wash as it trends east. Oil-stained rocks and asphalt-like deposits of hydrocarbons are present for approximately a mile down Little Valley Wash from the red arrow shown on these detail maps; the total extent of the oil staining and deposits is two miles in length. The labelled dots on these maps are references to GPS points and photos. An extensive photo library has been developed for this project; reference photographs are included in several appendices, notably the NorthWind report, Appendix A, and the event reconstruction, Appendix D.





**Map 3. As-built map of the Upper Valley Unit.** Well #27 is in the southeastern corner of the unit. The southernmost well shown here, Federal Well #1, lies to the south of Well #27, south of the unit boundary.



## **Background: The Upper Valley Unit, Well #27 and Little Valley Wash**

The Upper Valley Unit (UVU) includes 29 active wells, 18 producing oil wells (POW), 9 water injection wells (WIW), one water supply well (WSW) and one temporary abandoned (TA) well. The BLM administers the mineral estate for the UVU and the surface for 5 POW (#12, 18, 19, 21 & 27) and one WIW (#23). The remainder of the wells are on surface administered by the United States Forest Service (USFS).

The first well was drilled in May 1962 and the last well was completed in 1986. Well #27 was spudded 9/28/1971 and subsequently completed 11/27/1971 at a depth of 7,235 ft., with a 24 hour test of 336 barrels of oil and 788 barrels of water on 11/29/71. Citation purchased the oil field from Tenneco Oil Company, effective September 1, 1987. The UVU has produced over 28 million barrels of oil to date. At present, Well #27 is producing 15-17 barrels of oil per day; produced water is running around 400 barrels per day.

Little Valley Wash is the southernmost of several named drainages which lead away from the UVU onto GSENM, including Horse Spring Canyon, Canaan Creek, Willow Creek, Bear Hollow and Pet Hollow. Little Valley Wash, an intermittent wash, drains into a series of intermittent washes (Alvey Wash and Harris Wash), eventually draining to the Escalante River approximately 54 stream miles to the east (Map 1).

### **Initial Incident Reports**

BLM received a report of an oil spill in Little Valley Wash, one of the drainages leading from the Upper Valley Unit, from two unidentified hikers who contacted GSENM LEO Jeff Lauersdorf after returning from a hike on March 22. The hikers reported oil present in the canyon. Ranger Lauersdorf confirmed the information by patrolling the area on March 23. He identified oil splatter and evidence of spills 3 miles from the well head, Well #27. The hikers also contacted Brian Maffly, reporter, Salt Lake Tribune, who contacted BLM in turn and published the first news story on March 26 (Hikers find unreported oil spill, Salt Lake Tribune, March 26, 2014).

Ranger Lauersdorf also contacted the PET with responsibility for the Upper Valley Unit for BLM, Jeff Brown (Monticello Field Office). Brown's records did not include any report from Citation of the spills; these events appeared to have occurred before Citation took over lease holdings in the Upper Valley Unit. Brown also indicated that he had contacted USFS; they also had no reports on record about the three events. Note: During Brown's March 26 site visit, Citation Oil made him aware that they had repaired a leak on a pipeline associated with Well #27 in December of 2013. The December 2013 leak was not reported because it was primarily produced water brine (estimated to contain 5% oil) and less than the 10 barrel reporting threshold in place at the time.

### **BLM Initial Response**

- BLM contracted with NorthWind, Inc. to carry out rapid assessment of spilled material, March 26, 2014. NorthWind Senior Scientist, Bob Piper responded to BLM's request for soil and

vegetation sampling at the oil spill site on Monday, March 31, 2014. Accompanied by BLM Ranger Jeffery Lauersdorf, he hiked in the upper one-half mile of the Little Valley Wash to assess oil spill impacts on the streambed, soils, and vegetation. Piper collected soil and vegetation samples and created photographic documentation of the oil deposits. Piper and Lauersdorf followed the oil stained soil upstream to a culvert that crossed the main road accessing Citation Oil well #27 and to a pipeline that had recently been repaired. The oil stained soils stopped here. The final NorthWind report is included here as Appendix A.

- BLM resource specialists and managers conducted a field visit with USFS and Citation representatives, March 26, 2014. BLM staff included James Holland, geologist, Kanab Field Office, and Matt Betenson, Division Chief, Planning and Support, GSENM and Jeff Brown BLM PET; USFS personnel included Susan Baughman, Minerals Administrator, Dixie National Forest. Citation personnel included Daniel Benedict, Mark Bing and Gary Harding.
- On April 1, 2014, GSENM Acting Monument Manager Sarah Schlanger issued a Notice of Order to Citation Oil and Gas Corp. requiring Citation to notify the BLM within 24 hours of all undesirable events (releases) that originate from the Upper Valley Unit or within any rights-of-way associated with the Unit, regardless of volume. This order supersedes the 1982 requirement to report any spill ten barrels or greater in volume which enters a drainage channel. Citation has acknowledged this change in policy and expectation and indicated it will comply with the Notice.
- BLM developed a Spill Incident Team. Kent Hoffman, Utah State Office DSD, Minerals, and Mike Stiewig, Acting District Manager, Green River, assisted Team Leader Sarah Schlanger, Acting Monument Manager, GSENM. Also included on the team were Jeff Brown, Petroleum Engineering Technician (PET), BLM- Monticello; Randy Bywater, PET, BLM-Price; Tyler Cox, Natural Resource Specialist, BLM-Price; Lowell Jeffcoat and Tim Ingwell, Utah State Office Hazard Management, Response and Restoration; James Holland, Geologist, BLM-Kanab; Becky Hammond, UTSO; and Larry Crutchfield, GSENM. This team met regularly by conference call during field inspections, March 31-April 10, 2014.
- BLM tasked Jeff Brown, Randy Bywater, and Tyler Cox with completing a production inspection, April 2-3, 2014. This report is included as Appendix B. Note that Appendix B also includes a Site Visit report from March 27, 2013, which notes that a pipeline serving Well #27 was patched the previous week (mid-March 2013). [Citation Oil indicates that this line was actually repaired in December, 2013, and that the repair site was left uncovered for monitoring purposes.] This leak is the source of the most recent spill event described in this report. The leak associated with this patching event is not logged on the Undesirable Event Table included here as Appendix E; Citation Oil has indicated that this leak did not meet the threshold of 10 barrels of spilled material.

- BLM coordinated a split sample collection of five sample locations along Little Valley Wash with Arcadis, an environmental consulting firm contracted by Citation Oil and Gas Corp. on April 3 and 4, 2014. These samples were collected to clarify the temporal relationships between the several spill events which field teams had noted were present in the drainage. The forensic analysis completed by Arcadis is presented in Appendix A.
- BLM conducted a field reconnaissance of Little Valley Wash and other drainages associated with Upper Valley Unit by GSENM resource specialists during the weeks of March 31 and April 7, 2014 to determine if there were oil deposits in any of these drainages. See Appendix C for these reports.
- BLM also tasked GSENM Paleontologist Alan Titus and Archaeologist Matthew Zweifel with mapping the Little Valley Wash deposits and producing a reconstruction of spill events, to the extent possible, given the old age of the two primary spills. Their report, which describes three spill episodes, is included here as Appendix D. That report describes a “well” flow, which is the oldest of the three oil-depositing events associated with Little Valley Wash, and originates from the well head at Well #27; the other two spill episodes, including the recent spill of December 2013, originated from the pipeline.
- BLM and USFS conducted records searches of reported spills to determine if the oil deposits in Little Valley Wash could be associated with previously reported spills. Utah BLM’s Undesirable Event Log, the USFS records search results (which include information on the USFS wells only), and the results of search of the State of Utah Department of Environmental Quality, Division of Environmental Response and Remediation (UDEQ/DERR) are reported here in Appendix E.
- BLM and USFS initiated contact with former resource specialists and local residents to collect their anecdotal observations on previous spills and clean up activities in Little Valley Wash and other drainages associated with the Upper Valley Unit. These observations, although anecdotal and based on recall, are included below in the report section labelled “Observations Volunteered by Former BLM Employees Who Worked in Vicinity of Little Valley Wash and Upper Valley Unit.”
- Utah BLM coordinated information releases and media contacts through WO; by Monday, March 31, 2014 Utah BLM had assigned media coordination responsibilities to Larry Crutchfield, Public Information Officer, GSENM.

#### **Citation Leak Detection and Repair, December 1, 2013**

Citation submitted a spill report in sundry form. That notice describes the event as follows: “On December 1, 2013 a small leak was discovered on the Upper Valley #27 flowline. The leak was less than 24 hours old when discovered as the line was checked the previous day. The well was shut in and the flowline dug up. A small pinhole leak (size of ballpoint pen tip) was discovered on bottom

of the flowline. The leak was repaired with a flowline clamp. Left clamp uncovered to monitor flowline. Leak volume was estimated to be less than 10 barrels. Leak site has been remediated.”

Daniel Benedict, Operations Engineer, Central Region for Citation Oil & Gas Corp., spoke with field superintendent Gary Harding, and reported that “according to my notes from conversations with the field superintendent, after the well was shut in and the leak repaired, he observed small pools of oil and water confined to the mountain side of the road’s ditch, but nothing running across the road. He said because of the snow and icy conditions, it would be best and safest to wait until spring to do a more in-depth cleanup, but he was sure it was less than 10 barrels of fluid, so I agreed. Remediation on site consisted of blading the road, removing contaminated soil to the central battery where it would be taken to disposal, and finally dragging the road.” Note: At the time of this conversation, Gary Harding did not believe that spill from this leak had moved into the Little Valley Wash drainage. Subsequent field investigations have shown that this leak did flow into Little Valley Wash, probably in concert with melting snow and over both snow pack and ice, and did splatter trees, bushes, and other vegetation before reaching the drainage floor and following the path of an earlier leak from the pipeline.

## **Coordination with Environmental Protection Agency, US Army Corps of Engineers, State and other Federal Agencies**

*Environmental Protection Agency (EPA):* Shun-Ping Chau, on-scene coordinator, Region 8, Environmental Protection Agency (EPA), contacted GSENM on April 1, 2014 to determine if the discovered deposits had the potential to reach Waters of the USA and if EPA would want to send an on-scene coordinator. GSENM briefed Chau on the nature of the oil deposits, including the information that there was no currently active spill, and supplied Chau with maps showing the relationship between Little Valley Wash, an intermittent stream, and the Escalante River. Chau responded by email on April 3, 2014: “Based on the information you and Larry provided and the maps, we believe that EPA does not have jurisdiction over this spill as it is extremely unlikely the waxy oil will reach any waters of the United States. At this time I don’t think my supervisor feels the need to send one of us out. EPA should be notified if there is any change in the situation.”

*US Army Corps of Engineers (USACE):* On April 1, 2014 Kevin Miller, GSENM Science Program Administrator, contacted Pat McQueary, USACE St. George, regarding the question of whether the Corps would claim jurisdiction over these waters. On April 7, 2014 McQueary replied by telephone call that “they probably would (the stream is mapped as intermittent), but that they would likely only get involved if there was a permitting issue that came up, such as related to cleanup. The USACE will need to be notified of future actions or decisions that may necessitate Corps permitting.”

*Utah Division of Water Quality:* On April 18, 2014 Mike George, Utah Division of Water Quality, Engineering and Water Quality Branch Environmental Scientist, contacted Sarah Schlanger, GSENM, to discuss possible follow up actions the State of Utah may pursue with Citation regarding the oil deposits



in Little Valley Wash. George indicated that his agency considered Little Valley Wash to be a Water of the State, and the spill to be reportable to the State. The State of Utah will work directly with Citation to have the operator file a Storm Water Pollution Prevention Plan. BLM has no reporting responsibilities to the Division of Water Quality; George indicated that this responsibility lies with the operator.

*Oil Pollution Act Follow Up:* Lowell Jeffcoat, Utah BLM Program Lead, Hazard Management, Response and Restoration, is coordinating BLM responses under the Oil Pollution Act, and particularly Natural Resource Damage Assessment and Restoration (NRDAR) program. BLM is awaiting the results of field resource monitoring data, which is being collected through early summer of 2014, and will use this information as well as the results of the chemical analyses of spill material, included here in Appendix A, to determine next steps in this program.

## Analyses of Spill Material

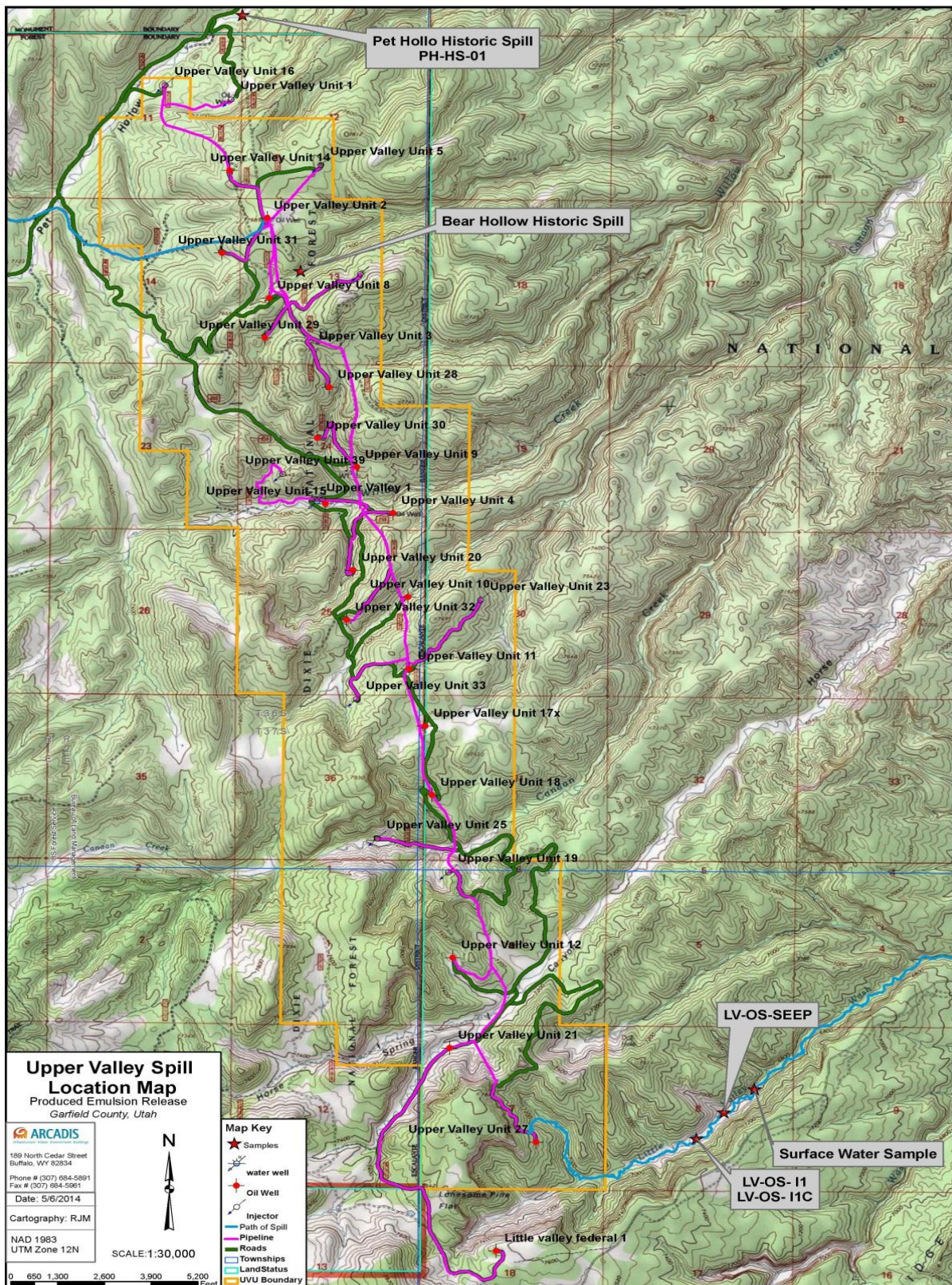
This report includes laboratory analyses conducted by NorthWind, Inc., an environmental hazards analysis firm contracted by BLM, and additional analyses conducted by Arcadis, an environmental firm contracted by Citation Oil and Gas, Corp. The purpose of the laboratory analyses coordinated by NorthWind was to characterize oil that was spilled into the Little Valley Wash in the GSENM to determine what types of contaminants were in the wash, determine the source of contamination, and to assess potential for environmental risk to the area. The Arcadis analyses were primarily forensic in nature, and were intended to assist in developing a history of spill events in Little Valley Wash. Arcadis also collected a sample for water quality analysis. See Map 4 for sample collection locations for Arcadis and BLM split samples.

*The NorthWind Sampling Protocols:* A composite soil sample was taken 300 feet below Citation's #27 well. A total of four 8-ounce amber jars were collected and placed in a cooler to cool to 4 degrees C for later analysis. The samples were delivered to the laboratory (ALS Laboratories, Salt Lake City) on April 1, 2014. The sample was later analyzed using Environmental Protection Agency Methods: EPA Method 6010 TCLP for leachable metals and EPA method SW 7471B (mercury) in order to obtain a waste profile for later hazardous waste disposal as required by RCRA regulations. EPA Method 6010 total methods was run to determine the total RCRA metal content to help evaluate the environmental risk. EPA Method 8260C and 8270D were used to determine the source of the petroleum contamination and whether the source of petroleum contamination was unprocessed crude oil from nearby oil wells or whether it was refined waste oil from another source. The laboratory analyses were expedited and laboratory results were received on April 3, 2014.

NorthWind's final letter report (Appendix A) concluded "This spill seems to be multiple events as indicated by the vegetation contamination. The re-growth on the Spruce stem that was collected indicates that approximately one year's growth occurred after a contamination event. Observations of other types of vegetation in Little Valley Wash indicate that a recent spill event occurred. This is evident by the staining on plant stems and seasonal re-growth beyond the contaminated stem areas. The analytical results of the contaminated soils indicate a number of metals that exceed EPA regulated levels. Further investigation of Little Valley Wash is needed to determine extents and frequency of releases in this drainage. Impacts to soils, groundwater and other natural systems and biota are unknown at this time. We suggest that temporary mitigation efforts be undertaken to contain further downstream contamination from recent spill events." (Note: At present remediation in place through biodegradation appears to be the best option).

**Map 4. Upper Valley Spill and Little Valley Wash Sample Locations.** Note: This map was prepared by Arcadis. It does not show the oldest spill, originating at the well location, which was identified by Alan Titus and Matthew Zweifel (see Appendices C and D for full description), and which is shown in this report on Map 2. The Bear Hollow and Pet Hollow spills were sampled for the purpose of identifying a weathering profile for spills in the area as part of the Arcadis forensic analysis; these two spills occurred in 1989 and between 1972 and 1986, respectively.







*Arcadis (Citation contractor) and GSENM Split Sample Collection Protocols:* On April 3 and 4, BLM NRS Tyler Cox and field specialists from Arcadis, an environmental consulting firm retained by Citation Oil and Gas, collected samples from Little Valley Wash for analysis following the EPA protocols on a split sample set. Arcadis submitted samples to Zymax Forensics, 600 S. Andreasen Drive, Suite B, Escondido, CA 92029. POC: Alan Jeffrey 760 781-3338. The BLM samples were submitted to EnviroPro, in Salt Lake City. The analyses and lab instructions called for by Arcadis and BLM include:

- C3-C10 (gasoline-range hydrocarbons) by high resolution gas chromatography mass spectrometry (GC/MS) [equivalent to USEPA Method 8260 modified to focus on petroleum hydrocarbon compounds] Identifies over 120 compounds in the gasoline range (C3-C10) for paraffin, isoparaffin, aromatic, naphthene, and olefin (PIANO) compound classes. Data are reported as concentrations for comparing compositional similarities between samples. Data can be used to evaluate relative extent of weathering of the C3-C10 hydrocarbons. Please have the fresh product sample extracted and analyzed in the same manner as the soil samples so data are directly comparable.
- Full Scan GC/MS [equivalent to USEPA Method 8270 modified to focus on petroleum hydrocarbon compounds] Provides distribution of alkanes, alkylbenzenes, polycyclic aromatic hydrocarbons (PAHs) and polycyclic biomarkers in the C10+ range. The distributions of compounds in the various compound classes provides information on the relative extent of weathering. Please have the fresh product sample extracted and analyzed in the same manner as the soil samples so data are directly comparable.
- TPH diesel by EPA Method 8015 [standard EPA Method] – “soil samples” only.

Arcadis developed a forensic analysis of the samples collected in Little Valley Wash and comparative samples collected from Pet Hollow (major spills undated, but most probably occurred between 1972 and 1986—See Appendix E, Documented Undesirable Event Logs, and Appendix C, GSENM Field Reports) and Bear Hollow (major spill of 500 barrels reported in 1989), to further understand the sequence of spill events in Little Valley Wash. They also analyzed a water sample collected from Little Valley Wash, from a flow formed by a natural seep along the drainage floor, for water quality. Their results are presented in Appendix A, in the report titled “Petroleum Hydrocarbon Forensics Technical Memorandum – Upper Valley Unit.”

The Arcadis report finds that the Little Valley Wash oil spill samples contain oil which is moderately weathered when compared to the more weathered samples from Pet Hollow and Bear Hollow. This report suggests that “the difference in weathering patterns for the Little Valley Wash soil samples compared with the Pet Hollow and Bear Hollow soil samples may be explained by historic spill response

practices including burial of oil-affected soil. Burial of oil-affected soil in the Little Valley Wash, either by spreading of dirt during a spill response or by natural processes in this active alluvial wash, may have resulted in retardation of the weather of oil compared with Pet Hollow and Bear Hollow where oil appeared to have been more exposed and subject to various weathering processes...[M]ultiple lines of evidence, including petroleum hydrocarbon forensic results, recent visual observations by a number of individuals, and anecdotal information regarding historical spill response practices, suggest that the vast majority of oil in Little Valley Wash is not of recent origin and is instead related to an historic release or releases that occurred early in the 42-year history of oil production at the head of the Little Valley Wash drainage.”

### **Observations Volunteered by Former BLM Employees Who Worked in the Vicinity of Little Valley Wash and Upper Valley Unit**

As news media reports of the discovered oil deposits began to circulate, residents and former BLM employees contacted several people involved to report their recollections of spills and remediation work in the area.

Below are two anecdotal statements from past BLM employees that Susan Baughman, USFS, Dixie National Forest Minerals Administrator collected in April, 2014, following initial media reports. Greg Christenson worked as a Range Management Specialist for the BLM in the Escalante area; Doug Powell worked as a geologist for the Kanab Field Office from 1998 to 2009. Baughman spoke with Christenson directly; the Powell comments were submitted via email to her.

Greg Christenson: He had worked as a range specialist in that area for the BLM and had direct knowledge of the Little Valley Wash. His recollection of that wash from 1980 when he began was that there were signs of oil deposits in that canyon at that time. He worked in that area for 24 years.

Doug Powell worked in the Kanab BLM from 1998 to 2009. Although at first he was uncertain about which canyons were involved he recalls past reports of old oil within some of the drainages east of the Upper Valley Field. Here is what was reported from Doug: *“from what I can remember, it was brought to the BLMs attention and I believe I went out with someone and visited the site. I believe at that time, it was much more obscure and more covered/buried. This was confirmed from someone that I spoke with that looked at past aerial photos. I vaguely remember that it might have been a little soft and somewhat odorous, but very intact and not environmentally unstable.”*

Sarah Schlanger spoke with Jerry Taylor, currently Mayor of Escalante, during the week of March 31, 2014. Taylor recalled working on oil remediation in the early 1970s as summer work for a construction company contracted to do clean up for the Upper Valley Field. He reported that between 1971 and 1973 he worked spreading dirt and burning pits, the then BLM-standard treatment for oil spills. Although he did not recall exactly which of the drainages leading from the field he worked in, he believed that he might have been involved in clean up of several of the drainages.

## Field Observations and Records Research: A Summary

Little Valley Wash exhibits evidence of three distinct spills or releases of oil and associated produced water. These spills have left oil residue from the head of the drainage down into the main body of the drainage. The most recent to reach the floor of the drainage occurred in December 2013, was not of reportable quantity, and was associated with the pipeline leak and repair of December 2013, as described above. The other distinct spill episodes occurred much earlier in the 42-year history of this well, and appear to be separated by a decade or more in time. The earliest may date to the 1971 drilling of Upper Valley Field Well #27; the second spill probably occurred in the 1980s.

All the oil deposits in Little Valley Wash originate with Well #27 or its associated pipeline to the battery. Neither BLM nor the USFS have any records of the three spill events described here; the Utah Department of Environmental Quality Division of Environmental Response and Remediation database searched by Lowell Jeffcoat, Utah BLM Hazard Management, Response and Restoration, shows 6 possible leaks reported to the State of Utah (see Appendix E, Utah Department of Environmental Quality/DERR records search). Four of these leaks involved crude oil; none of these can be definitively associated with Little Valley Wash. Greg Christenson's recollections of oil deposits in Little Valley Wash are the only field observation of early spills which can be definitively associated with Little Valley Wash, although Mayor Jerry Taylor recalls a summer job in the early 1970s performing clean up activities (spreading dirt and burning pits) in several canyons in the vicinity of the Upper Valley Unit.

The GSENM resources staff field reconnaissance of the other drainages north of Little Valley Wash revealed traces of apparently old spills in of these drainages, including Horse Spring Canyon, Canaan Creek, Bear Hollow and Pet Hollow. The BLM and USFS do have some records relating to leaks in Canaan Creek, Willow Creek, and Bear Hollow. These records are summarized in Appendix E. The records document spills from 1968 through 1987, in Willow Creek/Willow Springs drainage; in Canaan Creek from 1975 through 1988; and in Bear Hollow in 1989. The Bear Hollow report echoes our field reconnaissance report. It is likely that some of the reports document spills in Pet Hollow and Horse Spring Canyon; unfortunately the records do not always indicate a very precise location for the reported spill or spills.

It is not possible at this time to estimate the exact quantity of the most recent spill in Little Valley Wash; Citation has estimated the leak at less than 10 barrels. The leak was pinhole in size (i.e., diameter approximately the size of the tip of a pen) and was not significant enough to be detected by the well's pressure monitor safety equipment, which automatically shuts down production during anomalous pressure events.

## Monitoring and Remediation

At present, the most lasting impact of these spills appears to be to the remote, scenic, and unspoiled natural quality of this portion of the Grand Staircase-Escalante National Monument. BLM will continue to monitor natural resource conditions in Little Valley Wash, with particular attention to the quality of water flowing from seeps and the health of the native vegetation. A chemical analysis of water flowing over the older, asphalt-like deposits in the drainage show that the sample is well within Utah's surface water quality standards (see Appendix A, Arcadis Forensics Memo), and, although it is still early in the growing season, the vegetation in the drainage shows no apparent ill effects. Chemical analyses of oil-saturated soils from Little Valley Wash indicate that the lighter hydrocarbon fraction of the crude oil released into the wash is nearly completely depleted, and the material poses no significant threat to natural resources. The oil residues seen on living plants in the drainage will continue to weather and exfoliate, and the plants should suffer no long-term impacts. The thicker deposits on the drainage floor are susceptible to erosion during flash-flood events, however, and as the deposits are exposed, as they appear to have been following the scouring flash floods of September, 2013, oily residues may be remobilized and moved down the drainage. Small tar "balls" which are scattered the length of the drainage are probably being created and moved downstream during such flood events. Continued monitoring by BLM staff will reveal any long-term damage to natural resources, including wildlife, which may occur as a result of the spills.

Clean up and remediation options are limited by the difficulty of access to the most affected stretches of Little Valley Wash, which is narrow, boulder-choked, and largely inaccessible to heavy motorized equipment. Available options include leaving the oil deposits in place and relying on continued exposure to sunlight and air to break down the hydrocarbons and biodegrade the materials; mechanical or hand removal of the oil-saturated soils; and the development of catchment and containment systems to keep oil-affected soils and remobilized liquids from moving further down drainage. At present, remediation in place through biodegradation, and a robust monitoring program, appears to be the best option.

BLM will work with Citation Oil & Gas Corp. to conduct a thorough assessment of the Upper Valley Field infrastructure, including pipelines, monitoring equipment, and other equipment which may fail and lead to a spill event. BLM will work with Citation to research and evaluate all remediation options, as part of the development of Contingency Plans to be implemented as warranted by continued monitoring and/or future events.

BLM has already put Citation Oil & Gas Corp. on notice to report any spill, of any volume, that occurs in the Upper Valley Unit. BLM will also work with Citation Oil & Gas Corp. to prepare and implement a new surface use plan for the field. This plan will be developed in consultation with U.S. Forest Service, Dixie National Forest field administrators and BLM, and will include updated monitoring requirements and remediation options and treatments that recognize and take into account the



management goals for GSENM and the Monument Management Plan.

Near-term next steps for BLM include continued monitoring of impacts to vegetation, soils, and wildlife. The BLM and GSENM will continue monitoring of the drainages that lead from the Upper Valley Unit onto the national monument. We will provide cross-training in oil field monitoring for our back-country rangers and other resource specialists, and will develop monitoring routines which assess impacts to both natural resources and recreation resources present within GSENM in the area of the Upper Valley Unit. GSENM anticipates pairing up staff resource specialists with Natural Resource Specialists in Utah BLM for training on identifying and documenting natural resource impacts from oil and produced water spills. GSENM will work with the Utah State Office to develop appropriate remediation and restoration actions.

As part of a continuing plan of action and in addition to field personnel interaction, Citation representatives will be meeting onsite with the USFS and BLM quarterly to discuss operations, identify and address any concerns, and maintain lines of communication.

## **Appendices**

- A: NorthWind Final Report and Arcadis Forensics Memo
- B: Production inspection report and Natural Resources report
- C: GSENM Field Resource Reports
- D: Field Mapping and Event Reconstruction
- E: Undesirable Event Logs, BLM and USFS, and State of Utah Department of Environmental Quality, Division of Environmental Response and Remediation file search results

**Appendix A. NorthWind Final Letter Report and Arcadis Petroleum Hydrocarbon Forensics Technical Memorandum, Upper Valley Unit.** Note: The NorthWind report is included in full; Figures 1-26 of the Arcadis report are available on request, but summarized in the material included here in the Technical Memorandum. The reports reproduced here are as they were submitted to BLM.



04/10/2014

NW-2014-XXX

Lowell Jeffcoat  
Utah BLM Hazmat Coordinator  
Bureau of Land Management  
Utah State Office  
440 West 200 South Ste. 500  
Salt Lake City, UT 84101

SUBJECT: Little Valley Wash Oil Spill Sampling AZ12S6W09001 Contract # L1IPC00074

Dear Mr. Jeffcoat:

#### **Introduction**

As requested by Utah Bureau of Land Management (BLM), North Wind Inc. (NWI) responded to an oil spill site within Grand Staircase Escalante Monument to collect soil samples and assess the source and approximate age of the spill. The sample site is located at UTM 12S 0436467E 4161890N in Little Valley Wash approximately 150 yards east and down gradient of Citation Oil #27 well location. The well location is approximately 22 miles southeast of Escalante, UT via Smokey Mountain Road (see Appendix A).

NWI Senior Principal Scientist Bob Piper responded to the BLM's request for soil and vegetation sampling at the oil spill site. Mr. Piper met Jeffery Lauersdorf, BLM Law Enforcement Officer, at the Grand Staircase-Escalante Visitors Center in Escalante, UT on Monday, May 31, 2014. Mr. Piper and Officer Lauersdorf were on-site at 1100 hrs to commence sampling and taking photographs. Mr. Piper and Officer Lauersdorf hiked into the upper one-half mile of the Little Valley Wash to assess the oil spill impacts on the streambed, soils, and vegetation and collected soil and vegetation samples and photographic evidence (see Appendix B). Mr. Piper and Officer Lauersdorf then followed the oil stained soil upstream to a culvert that crossed the main road accessing Citation Oil #27 well and to a recent pipe repair where the oil stained soils stopped. They noted that there were multiple points that oily liquids had accessed Little Valley Wash, one being the stained culvert and the other being a rock fissure in the borrow pit adjacent to the well access road. Multiple photographs were taken and soil and vegetation samples collected and turned over to BLM.

#### **Investigation Results**

A composite soil sample from the oil contaminated streambed was collected. A total of 4 (8 oz amber jars) were collected for analysis. The samples were placed in a cooler with ice to cool to 4° C. The sample was analyzed using Environmental Protection Agency Methods SW6010C TCLP, SW6010C Soil, SW7471B TCLP, SW7471B Soil, SW 8260C Soil and SW 8270D Soil. The analysis was conducted by ALS Environmental, Salt Lake City, UT. The vegetation sample is preserved for further investigation following standard herbarium practices. Sample results are included in Appendix C.



#### Discussion

This spill seems to be multiple events as indicated by the vegetation contamination. The re-growth on the Spruce stem that was collected indicates that approximately one year's growth occurred after a contamination event. Observations of other types of vegetation in Little Valley Wash indicate that a recent spill event occurred. This is evident by the staining on plant stems and seasonal re-growth beyond the contaminated stem areas. The analytical results of the contaminated soils indicate a number of metals that exceed EPA regulated levels. Further investigation of Little Valley Wash is needed to determine extents and frequency of releases in this drainage. Impacts to soils, groundwater and other natural systems and biota are unknown at this time. We suggest that temporary mitigation efforts be undertaken to contain further downstream contamination from recent spill events.

Sincerely,  
Robert Piper CES

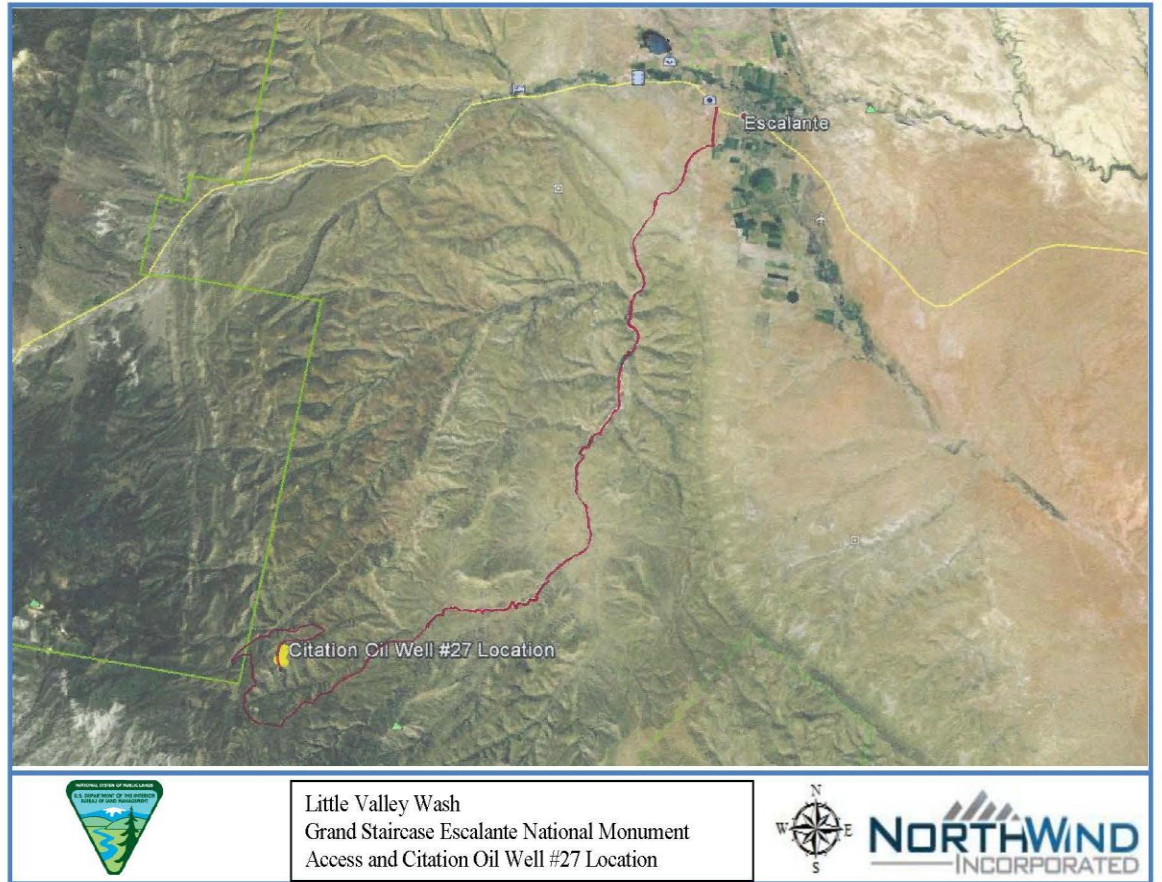
A handwritten signature in black ink, appearing to read "Robert A. Piper", with a long, sweeping horizontal line extending to the right.

Enclosure

cc: Doug Jorgensen  
Jace Fahnestock



Appendix A  
Location Map



7749 Oakshadow Circle, Salt Lake City, UT {801-520-9363} [www.northwindgrp.com](http://www.northwindgrp.com)





**Appendix B**  
**Photos**



<b>Date</b>	<b>Time</b>	<b>Direction of View</b>
3/31/14	1223	SW
<b>Subject</b>		
Oil stained spruce tree with sand covered oil.		



<b>Date</b>	<b>Time</b>	<b>Direction of View</b>
3/31/14	1246 hrs	Down
<b>Subject</b>		
Spruce branch with oil staining and new growth.		





<b>Date</b>	<b>Time</b>	<b>Direction of View</b>
3/31/14	1214	Down
<b>Subject</b>		
Sampling trowel with oil contaminated soil.		





<b>Date</b>	<b>Time</b>	<b>Direction of View</b>
3/31/14	1139	East
<b>Subject</b>		
Little Valley Wash from Citation Oil Well #27 with old mud pit location in foreground.		

7749 Oakshadow Circle, Salt Lake City, UT {801-520-9363} [www.northwindgrp.com](http://www.northwindgrp.com)



<b>Date</b>	<b>Time</b>	<b>Direction of View</b>
3/31/14	1310 hrs	SW
<b>Subject</b>		
Oil staining on rock		

7749 Oakshadow Circle, Salt Lake City, UT {801-520-9363} [www.northwindgrp.com](http://www.northwindgrp.com)



**Appendix C**  
**Sample Analysis Results**



**ANALYTICAL REPORT**

Report Date: April 03, 2014

Bob Piper  
North Wind, Inc.  
7749 Oakshadow Circle  
Cottonwood Heights, UT 84121

Phone: (801) 520-9363

E-mail: [rpiper@northwindgrp.com](mailto:rpiper@northwindgrp.com)

Workorder: **34-1409156**

Project ID: Little Valley Wash Oil Spill

Purchase Order: Little Valley

Client Sample ID	Lab ID	Collect Date	Receive Date	Sampling Site
Little Valley Wash 033114	1409156001	03/31/14	04/01/14	Little Valley

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ADDRESS 960 West LeVoy Drive, Salt Lake City, Utah, 84123 USA PHONE +1 801 266 7700 FAX +1 801 268 5992  
ALS GROUP USA, CORP.



# ANALYTICAL REPORT

Workorder: **34-1409156**  
 Client: North Wind, Inc.  
 Project Manager: Kevin W. Griffiths

## Analytical Results

Sample ID: <b>Little Valley Wash 033114</b>		Sampling Site: Little Valley		Collected: 03/31/2014	
Lab ID: 1409156001		Media: 4 oz Amber Glass Jar		Received: 04/01/2014	
Matrix: Soil/Solid/Sediment		Sampling Parameter: NA			
<b>Analysis Method - SW 6010C</b>					
Preparation: SW-346, EPA 3050 Soil Prep		<u>Weight/Volume</u>		Analysis: SW 6010C, Soil	
Batch: EIPX/4816 (HBN: 124153)		Initial: 1.2114 grams		Batch: EICP/4447 (HBN: 124192)	
Prepared: 04/02/2014		Final: 100 mL		Analyzed: 04/02/2014 16:45	
				Instrument ID: ICP08	
				Percent Solid: 88.3	
				Report Basis: Dry	
Analyte	ug/g	MDL (ug/g)	RL (ug/g)	Dilution	Qual.
Arsenic	4.83	0.28	0.93	1	
Barium	23.3	0.56	1.9	1	
Cadmium	ND	0.14	0.47	1	U
Chromium	5.30	0.28	0.93	1	
Lead	6.80	0.28	0.93	1	
Selenium	0.862	0.56	1.9	1	J
Silver	ND	0.28	0.93	1	U
<b>Analysis Method - SW 6010C</b>					
Preparation: EPA 3010 SPLP/TCLP, Prep		<u>Weight/Volume</u>		Analysis: SW 6010C SPLP/TCLP, Water	
Batch: EIPX/4815 (HBN: 124159)		Initial: 25 mL		Batch: EICP/4448 (HBN: 124255)	
Prepared: 04/02/2014		Final: 50 mL		Analyzed: 04/02/2014 17:30	
				Instrument ID: ICP08	
				Percent Solid: 88.3	
				Report Basis: Wet	
Analyte	mg/L	Reg. Limit (mg/L)	RL (mg/L)	Dilution	Qual.
Arsenic	ND	5.0	0.60	1	
Barium	1.70	100	0.040	1	
Cadmium	ND	1.0	0.020	1	
Chromium	ND	5.0	0.040	1	
Lead	ND	5.0	0.20	1	
Selenium	ND	1.0	0.60	1	
Silver	ND	5.0	0.040	1	
<b>Analysis Method - SW 7470</b>					
Preparation: SW 7470A SPLP/TCLP, Water Prep		<u>Weight/Volume</u>		Analysis: SW 7470A SPLP/TCLP, Water	
Batch: EHG/5287 (HBN: 124165)		Initial: 25 mL		Batch: EHG/5286 (HBN: 124221)	
Prepared: 04/02/2014		Final: 50 mL		Analyzed: 04/03/2014 10:12	
				Instrument ID: AACV02	
				Percent Solid: 88.3	
				Report Basis: Wet	
Analyte	mg/L	Reg. Limit (mg/L)	RL (mg/L)	Dilution	Qual.
Mercury	ND	0.20	0.00020	1	
<b>Analysis Method - SW 7471B</b>					
Preparation: SW 7471B, Prep		<u>Weight/Volume</u>		Analysis: SW 7471B, Soil	
Batch: EHG/5286 (HBN: 124164)		Initial: 0.546 grams		Batch: EHG/5289 (HBN: 124223)	
Prepared: 04/02/2014		Final: 100 mL		Analyzed: 04/03/2014 10:40	
				Instrument ID: AACV02	
				Percent Solid: 88.3	
				Report Basis: Dry	
Analyte	ug/g	MDL (ug/g)	RL (ug/g)	Dilution	Qual.
Mercury	0.029	0.0062	0.021	1	
<b>Analysis Method - SW 8260</b>					
Preparation: Not Applicable				Analysis: SW 8260C, Soil	
				Batch: EVO/4961 (HBN: 124136)	
				Analyzed: 04/01/2014 23:46	
				Instrument ID: 5975-E	
				Percent Solid: 88.3	
				Report Basis: Dry	
Analyte	ug/Kg	MDL (ug/Kg)	RL (ug/Kg)	Dilution	Qual.
Dichlorodifluoromethane	ND	1.9	6.2	1	U
Chloromethane	ND	1.9	6.2	1	U

Results Continued on Next Page





## ANALYTICAL REPORT

Workorder: **34-1409156**  
 Client: North Wind, Inc.  
 Project Manager: Kevin W. Griffiths

### Analytical Results

Sample ID: **Little Valley Wash 033114** Sampling Site: Little Valley Collected: 03/31/2014  
 Lab ID: 1409156001 Media: 4 oz Glass Jar Wide Mouth Received: 04/01/2014  
 Matrix: Soil/Solid/Sediment Sampling Parameter: NA

### Analysis Method - SW 8260

Preparation: Not Applicable

Analysis: SW 8260C, Soil Instrument ID: 5975-E  
 Batch: EVO4961 (HBN 124136) Percent Solid: 88.3  
 Analyzed: 04/01/2014 23:46 Report Basis: Dry

Analyte	ug/Kg	MDL (ug/Kg)	RL (ug/Kg)	Dilution	Qual.
Vinyl chloride	ND	1.9	6.2	1	U
Bromomethane	ND	1.9	6.2	1	U
Chloroethane	ND	1.9	6.2	1	U
Dichlorofluoromethane	ND	1.9	6.2	1	U
Trichlorofluoromethane	ND	1.9	6.2	1	U
Ethyl ether	ND	1.9	6.2	1	U
1,1-Dichloroethene	ND	1.9	6.2	1	U
Freon 113	ND	1.9	6.2	1	U
Acetone	3.6	1.9	6.2	1	J
Iodomethane	ND	2.5	6.2	1	U
Carbon disulfide	ND	1.9	6.2	1	U
Methyl Acetate	ND	1.9	6.2	1	U
Allyl chloride	ND	1.9	6.2	1	U
Methylene chloride	ND	1.9	6.2	1	U
trans-1,2-Dichloroethane	ND	1.9	6.2	1	U
Methyl-t-butyl ether	ND	1.9	6.2	1	U
cis-1,2-Dichloroethene	ND	1.9	6.2	1	U
1,1-Dichloroethane	ND	1.9	6.2	1	U
2,2-Dichloropropane	ND	1.9	6.2	1	U
2-Butanone	ND	2.1	6.2	1	U
Ethyl acetate	ND	2.4	6.2	1	U
Bromochloromethane	ND	1.9	6.2	1	U
Tetrahydrofuran	ND	1.9	6.2	1	U
Chloroform	ND	1.9	6.2	1	U
1,1,1-Trichloroethane	ND	1.9	6.2	1	U
Cyclohexane	ND	1.9	6.2	1	U
1,1-Dichloropropene	ND	1.9	6.2	1	U
1,2-Dichloroethane	ND	1.9	6.2	1	U
Carbon tetrachloride	ND	1.9	6.2	1	U
Benzene	ND	1.9	6.2	1	U
Trichloroethene	ND	1.9	6.2	1	U
Methylcyclohexane	ND	1.9	6.2	1	U
1,2-Dichloropropane	ND	1.9	6.2	1	U
Dibromomethane	ND	1.9	6.2	1	U
Bromodichloromethane	ND	1.9	6.2	1	U
cis-1,3-Dichloropropene	ND	1.9	6.2	1	U

Results Continued on Next Page



## ANALYTICAL REPORT

Workorder: **34-1409156**  
 Client: North Wind, Inc.  
 Project Manager: Kevin W. Griffiths

### Analytical Results

Sample ID: <b>Little Valley Wash 033114</b>		Sampling Site: Little Valley		Collected: 03/31/2014	
Lab ID: 1409156001		Media: 4 oz Glass Jar Wide Mouth		Received: 04/01/2014	
Matrix: Soil/Solid/Sediment		Sampling Parameter: NA			
<b>Analysis Method - SW 8260</b>					
Preparation: Not Applicable			Analysis: SW 8260C, Soil Batch: EVO4961 (HBN 124136) Analyzed: 04/01/2014 23:46		Instrument ID: 5975-E Percent Solid: 88.3 Report Basis: Dry
Analyte	ug/Kg	MDL (ug/Kg)	RL (ug/Kg)	Dilution	Qual.
4-Methyl-2-pentanone	ND	1.9	6.2	1	U
trans-1,3-Dichloropropene	ND	1.9	6.2	1	U
Ethyl methacrylate	ND	1.9	6.2	1	U
1,1,2-Trichloroethane	ND	1.9	6.2	1	U
2-Hexanone	ND	1.9	6.2	1	U
1,2-Dibromoethane	ND	1.9	6.2	1	U
Toluene	ND	1.9	6.2	1	U
1,3-Dichloropropene	ND	1.9	6.2	1	U
Dibromochloromethane	ND	1.9	6.2	1	U
Bromoform	ND	1.9	6.2	1	U
Tetrachloroethane	ND	1.9	6.2	1	U
1-Chlorohexane	ND	1.9	6.2	1	U
Chlorobenzene	ND	1.9	6.2	1	U
1,1,1,2-Tetrachloroethane	ND	1.9	6.2	1	U
Ethylbenzene	ND	1.9	6.2	1	U
m,p-Xylene	ND	1.9	12	1	U
o-Xylene	ND	1.9	6.2	1	U
Styrene	ND	1.9	6.2	1	U
Isopropylbenzene	ND	1.9	6.2	1	U
1,1,2,2-Tetrachloroethane	ND	1.9	6.2	1	U
Bromobenzene	ND	1.9	6.2	1	U
1,2,3-Trichloropropene	ND	1.9	6.2	1	U
trans-1,4-Dichloro-2-butene	ND	1.9	6.2	1	U
Pentachloroethane	ND	1.9	6.2	1	U
n-Propylbenzene	ND	1.9	6.2	1	U
1,3,5-Trimethylbenzene	ND	1.9	6.2	1	U
2-Chlorotoluene	ND	1.9	6.2	1	U
4-Chlorotoluene	ND	1.9	6.2	1	U
tert-Butylbenzene	ND	1.9	6.2	1	U
1,2,4-Trimethylbenzene	ND	1.9	6.2	1	U
sec-Butylbenzene	ND	1.9	6.2	1	U
p-Isopropyltoluene	ND	1.9	6.2	1	U
1,3-Dichlorobenzene	ND	1.9	6.2	1	U
1,4-Dichlorobenzene	ND	1.9	6.2	1	U
n-Butylbenzene	ND	1.9	6.2	1	U
1,2-Dichlorobenzene	ND	1.9	6.2	1	U

Results Continued on Next Page

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Thu, 04/03/14 3:11 PM

ENVREP-V3.3



## ANALYTICAL REPORT

Workorder: **34-1409156**

Client: North Wind, Inc.  
Project Manager: Kevin W. Griffiths

### Analytical Results

Sample ID: <b>Little Valley Wash 033114</b>	Sampling Site: Little Valley	Collected: 03/31/2014
Lab ID: 1409156001	Media: 4 oz Glass Jar Wide Mouth	Received: 04/01/2014
Matrix: Soil/Solid/Sediment	Sampling Parameter: NA	

#### Analysis Method - SW 8260

Preparation: Not Applicable			Analysis: SW 8260C, Soil Batch: EVO/4961 (HBN: 124136) Analyzed: 04/01/2014 23:46		Instrument ID: 5975-E Percent Solid: 88.3 Report Basis: Dry	
Analyte	ug/Kg	MDL (ug/Kg)	RL (ug/Kg)	Dilution	Qual.	
1,2-Dibromo-3-Chloropropane	ND	1.9	6.2	1	U	
1,2,4-Trichlorobenzene	ND	1.9	6.2	1	U	
Hexachlorobutadiene	ND	1.9	6.2	1	U	
Naphthalene	2.7	1.9	6.2	1	J	
1,2,3-Trichlorobenzene	ND	1.9	6.2	1	U	

#### Analysis Method - SW 8260

Preparation: Not Applicable		Analysis: SW 8260C, Soil Batch: EVO/4961 (HBN 124136) Analyzed: 04/01/2014 23:46		Instrument ID: 5975-E Percent Solid: 88.3 Report Basis: Dry	
Tentatively Identified Compound	ug/Kg	Retention Time	Dilution	Qual.	
Undecane, 2,6-dimethyl-	38	14.48	1	J	
C13 Cyclic Hydrocarbon	79	14.93	1	J	
Unknown Hydrocarbon	57	15.05	1	J	
C14 Hydrocarbon	110	15.09	1	J	
Dodecane, 2,5-dimethyl-	130	15.51	1	J	
C14 Hydrocarbon	200	16.04	1	J	
Tetradecane	240	16.17	1	J	
Cyclohexane, 1,1,3-trimethyl-2-(3-methylpentyl)-	110	16.43	1	J	
C15 Hydrocarbon	120	16.69	1	J	
Pentadecane	120	16.93	1	J	

#### Analysis Method - SW 8270

Preparation: EPA 3550, Sonic Ext. SVOA Soil Batch: ENVX/18652 (HBN: 124121) Prepared: 04/01/2014		Weight/Volume Initial: 30.06 grams Final: 5 mL		Analysis: SW 8270D, Soil Batch: ESVO/4473 (HBN: 124161) Analyzed: 04/02/2014 08:37		Instrument ID: 5975-H Percent Solid: 88.3 Report Basis: Dry	
Analyte	ug/Kg	MDL (ug/Kg)	RL (ug/Kg)	Dilution	Qual.		
Pyridine	ND	11000	38000	40	U		
Phenol	ND	11000	38000	40	U		
Bis(2-chloroethyl)ether	ND	11000	38000	40	U		
2-Chlorophenol	ND	11000	38000	40	U		
1,3-Dichlorobenzene	ND	11000	38000	40	U		
1,4-Dichlorobenzene	ND	11000	38000	40	U		
Benzyl alcohol	ND	14000	38000	40	U		
1,2-Dichlorobenzene	ND	11000	38000	40	U		
2-Methylphenol	ND	11000	38000	40	U		
bis(2-Chloroisopropyl)ether	ND	12000	38000	40	U		
4-Methylphenol	ND	11000	38000	40	U		
N-Nitrosodi-n-propyl amine	ND	11000	38000	40	U		

Results Continued on Next Page





## ANALYTICAL REPORT

Workorder: **34-1409156**  
 Client: North Wind, Inc.  
 Project Manager: Kevin W. Griffiths

### Analytical Results

Sample ID: **Little Valley Wash 033114** Sampling Site: Little Valley Collected: 03/31/2014  
 Lab ID: 1409156001 Media: 8 oz Glass Jar Wide Mouth Received: 04/01/2014  
 Matrix: Soil/Solid/Sediment Sampling Parameter: NA

### Analysis Method - SW 8270

Preparation: EPA 3550, Sonic Ext, SVOA Soil Weight/Volume Analysis: SW 8270D, Soil Instrument ID: 5975-H  
 Batch: ENVX/18652 (HBN: 124121) Initial: 30.06 grams Batch: ESVO/4473 (HBN: 124161) Percent Solid: 88.3  
 Prepared: 04/01/2014 Final: 5 mL Analyzed: 04/02/2014 08:37 Report Basis: Dry

Analyte	ug/Kg	MDL (ug/Kg)	RL (ug/Kg)	Dilution	Qual.
Hexachloroethane	ND	11000	38000	40	U
Nitrobenzene	ND	11000	38000	40	U
Isophorone	ND	11000	38000	40	U
2-Nitrophenol	ND	11000	38000	40	U
2,4-Dimethylphenol	ND	18000	38000	40	U
Benzoic acid	ND	71000	150000	40	U
Bis(2-Chloroethoxy)methane	ND	11000	38000	40	U
2,4-Dichlorophenol	ND	11000	38000	40	U
1,2,4-Trichlorobenzene	ND	11000	38000	40	U
Naphthalene	ND	11000	38000	40	U
4-Chloroaniline	ND	17000	38000	40	U
Hexachlorobutadiene	ND	11000	38000	40	U
4-Chloro-3-methylphenol	ND	11000	38000	40	U
2-Methylnaphthalene	ND	11000	38000	40	U
Hexachlorocyclopentadiene	ND	29000	38000	40	U
2,4,6-Trichlorophenol	ND	11000	38000	40	U
2,4,5-Trichlorophenol	ND	11000	38000	40	U
2-Chloronaphthalene	ND	11000	38000	40	U
2-Nitroaniline	ND	11000	38000	40	U
Dimethylphthalate	ND	11000	38000	40	U
2,6-Dinitrotoluene	ND	11000	38000	40	U
Acenaphthylene	ND	11000	38000	40	U
3-Nitroaniline	ND	23000	38000	40	U
Acenaphthene	ND	11000	38000	40	U
2,4-Dinitrophenol	ND	160000	280000	40	U
4-Nitrophenol	ND	45000	150000	40	U
Dibenzofuran	ND	11000	38000	40	U
2,4-Dinitrotoluene	ND	11000	38000	40	U
Diethylphthalate	ND	11000	38000	40	U
4-Chlorophenyl phenyl ether	ND	11000	38000	40	U
Fluorene	ND	11000	38000	40	U
4-Nitroaniline	ND	14000	38000	40	U
4,6-Dinitro-2-methylphenol	ND	140000	280000	40	U
N-Nitrosodiphenylamine	ND	11000	38000	40	U
4-Bromophenyl phenyl ether	ND	11000	38000	40	U
Hexachlorobenzene	ND	11000	38000	40	U

Results Continued on Next Page



## ANALYTICAL REPORT

Workorder: **34-1409156**  
 Client: North Wind, Inc.  
 Project Manager: Kevin W. Griffiths

### Analytical Results

Sample ID: **Little Valley Wash 033114** Sampling Site: Little Valley Collected: 03/31/2014  
 Lab ID: 1409156001 Media: 8 oz Glass Jar Wide Mouth Received: 04/01/2014  
 Matrix: Soil/Solid/Sediment Sampling Parameter: NA

### Analysis Method - SW 8270

Preparation: EPA 3550, Sonic Ext, SVOA Soil Weight/Volume Analysis: SW 8270D, Soil Instrument ID: 5975-H  
 Batch: ENVX/18652 (HBN: 124121) Initial: 30.06 grams Batch: ESVO/4473 (HBN: 124161) Percent Solid: 88.3  
 Prepared: 04/01/2014 Final: 5 mL Analyzed: 04/02/2014 08:37 Report Basis: Dry

Analyte	ug/Kg	MDL (ug/Kg)	RL (ug/Kg)	Dilution	Qual.
Pentachlorophenol	ND	45000	150000	40	U
Phenanthrene	ND	11000	38000	40	U
Anthracene	ND	11000	38000	40	U
Carbazole	ND	11000	38000	40	U
Di-n-butylphthalate	ND	11000	38000	40	U
Fluoranthene	ND	11000	38000	40	U
Pyrene	ND	11000	38000	40	U
Butylbenzylphthalate	ND	11000	38000	40	U
3,3'-Dichlorobenzidine	ND	15000	38000	40	U
Benzo(e)anthracene	ND	11000	38000	40	U
Chrysene	ND	11000	38000	40	U
Bis(2-ethylhexyl)phthalate	ND	11000	38000	40	U
Di-n-octylphthalate	ND	11000	38000	40	U
Benzo(b)fluoranthene	ND	11000	38000	40	U
Benzo(k)fluoranthene	ND	11000	38000	40	U
Benzo(a)pyrene	ND	11000	38000	40	U
Indeno(1,2,3-c,d)pyrene	ND	11000	38000	40	U
Dibenz(a,h)anthracene	ND	11000	38000	40	U
Benzo(g,h,i)perylene	ND	11000	38000	40	U

### Analysis Method - SW 8270

Preparation: EPA 3550, Sonic Ext, SVOA Soil Weight/Volume Analysis: SW 8270D, Soil Instrument ID: 5975-H  
 Batch: ENVX/18652 (HBN: 124121) Initial: 30.06 grams Batch: ESVO/4473 (HBN: 124161) Percent Solid: 88.3  
 Prepared: 04/01/2014 Final: 5 mL Analyzed: 04/02/2014 08:37 Report Basis: Dry

Tentatively Identified Compound	ug/Kg	Retention Time	Dilution	Qual.
Pentadecane	39000	8.69	40	J
Hexadecane	51000	9.58	40	J
Hexadecane, 3-methyl-	40000	9.99	40	J
Heptadecane	59000	10.45	40	J
Tetradecane	57000	11.29	40	J
Hexadecane, 2,6,10,14-tetramethyl-	54000	11.35	40	J
Nonadecane	54000	12.09	40	J
Eicosane	60000	12.86	40	J
Heptacosane	53000	13.54	40	J
Heptacosane	46000	14.13	40	J
Heptadecane	43000	14.66	40	J
Tetracosane	40000	15.14	40	J

Results Continued on Next Page



## ANALYTICAL REPORT

Workorder: **34-1409156**  
 Client: North Wind, Inc.  
 Project Manager: Kevin W. Griffiths

### Analytical Results

Sample ID: <b>Little Valley Wash 033114</b>	Sampling Site: Little Valley	Collected: 03/31/2014
Lab ID: 1409156001	Media: 8 oz Glass Jar Wide Mouth	Received: 04/01/2014
Matrix: Soil/Solid/Sediment	Sampling Parameter: NA	

### Analysis Method - SW 8270

Preparation: EPA 3550, Sonic Ext, SVOA Soil	Weight/Volume	Analysis: SW 8270D, Soil	Instrument ID: 5975-H
Batch: ENVX/18652 (HBN: 124121)	Initial: 30.06 grams	Batch: ESVO/4473 (HBN: 124161)	Percent Solid: 88.3
Prepared: 04/01/2014	Final: 5 mL	Analyzed: 04/02/2014 08:37	Report Basis: Dry

Tentatively Identified Compound	ug/Kg	Retention Time	Dilution	Qual.
Docosane	38000	15.59	40	J
Hexatriacontane	43000	16.06	40	J

### Comments

Workorder: 1409156

8260 Comments: The sample failed some internal standard and surrogate recovery limits when originally analyzed. It was re-analyzed as an MS and MSD where it again failed indicating matrix effect. No further re-analyses were performed. The ten largest unknowns were reported.

Sample: 1409156001

SW 6010C: TCLP Sample 1409156001 and its associated matrix QC's were prepared with a 2x dilution due to matrix issues.

Quality Control: SW 6010C - (HBN: 124192)

MD 383090 is out of control limits for lead, due to possible matrix issues.

Quality Control: SW 7470 - (HBN: 124221)

TCLP extracts for mercury analysis were diluted 2-fold prior to sample digestion by taking 25mL initial sample volume to 50mL final volume with ASTM Type II water. This was done in order to reduce potential matrix effects. The reporting limit was also raised by the dilution factor.

The mercury recovery from the post digestion spike is at 117% which is 2% above the control limits of 85-115%. This result is comparable to the matrix spike and matrix spike duplicate mercury recoveries. No significant matrix effects are suspected.

Quality Control: SW 8260 - (HBN: 124136)

8260 Comments: As the LCS is a clean matrix and all compounds passed it can be assumed that any MS/MSD failures are the result of matrix effect.

Quality Control: SW 8270 - (HBN: 124161)

The recoveries of all of the spike compounds were within the required limits in the laboratory control sample and hence the extraction is deemed valid.

The spike compounds in the MS/MSD analyses were diluted out due to the dilution factors employed.

The surrogate recoveries were also diluted out of sample 1409156001 and the MS/MSD analyses.

### Report Authorization

Method	Analyst	Peer Review
SW 6010C	Neil A. Edwards	Penny A. Foote
SW 7470	Christopher R. Hansen	Kelsey Lockwood
SW 7471B	Christopher R. Hansen	Kelsey Lockwood
SW 8260	Christopher Q. Coleman	Thomas J. Masoian
SW 8270	Brett J. Murphy	Richard W. Wade
Solids/Moisture Determination	Ilse J. O'valle	Christopher Winter



## ANALYTICAL REPORT

Workorder: **34-1409156**

Client: North Wind, Inc.  
Project Manager: Kevin W. Griffiths

### Laboratory Contact Information

ALS Environmental  
960 W Levoe Drive  
Salt Lake City, Utah 84123

Phone: (801) 295-7700  
Email: [alslt.lab@ALSGlobal.com](mailto:alslt.lab@ALSGlobal.com)  
Web: [www.alsic.com](http://www.alsic.com)

### General Lab Comments

The results provided in this report relate only to the items tested.  
Samples were received in acceptable condition unless otherwise noted.  
Samples have not been blank corrected unless otherwise noted.  
This test report shall not be reproduced, except in full, without written approval of ALS.

ALS provides professional analytical services for all samples submitted. ALS is not in a position to interpret the data and assumes no responsibility for the quality of the samples submitted.

All quality control samples processed with the samples in this report yielded acceptable results unless otherwise noted.

ALS is accredited for specific fields of testing (scopes) in the following testing sectors. The quality system implemented at ALS conforms to accreditation requirements and is applied to all analytical testing performed by ALS. The following table lists testing sector, accreditation body, accreditation number and website. Please contact these accrediting bodies or your ALS project manager for the current scope of accreditation that applies to your analytical testing.

Testing Sector	Accreditation Body (Standard)	Certificate Number	Website
Environmental	AClass (DoD ELAP)	ADE-1420	<a href="http://www.aclasscorp.com">http://www.aclasscorp.com</a>
	Utah (NELAC)	DATA1	<a href="http://health.utah.gov/lab/labinfo/">http://health.utah.gov/lab/labinfo/</a>
	Nevada	UT00009	<a href="http://ndep.nv.gov/bsow/labservice.htm">http://ndep.nv.gov/bsow/labservice.htm</a>
	Oklahoma	UT00009	<a href="http://www.deq.state.ok.us/CSDnew/">http://www.deq.state.ok.us/CSDnew/</a>
	Iowa	IA# 376	<a href="http://www.iowadnr.gov/InsideDNR/Regulatory/Water.aspx">http://www.iowadnr.gov/InsideDNR/Regulatory/Water.aspx</a>
	Florida (TNI)	E871067	<a href="http://www.dep.state.fl.us/labs/bars/sas/qa/">http://www.dep.state.fl.us/labs/bars/sas/qa/</a>
Industrial Hygiene	Texas (TNI)	T104704456-11-1	<a href="http://www.tceq.texas.gov/field/qa/lab_accred_certif.html">http://www.tceq.texas.gov/field/qa/lab_accred_certif.html</a>
	AIHA (ISO 17025 & AIHA IHLAP/ELLAP)	101574	<a href="http://www.aihaaccreditedlabs.org">http://www.aihaaccreditedlabs.org</a>
Lead Testing: CPSC Soil, Dust, Paint, Air	AClass (ISO 17025, CPSC)	ADE-1420	<a href="http://www.aclasscorp.com">http://www.aclasscorp.com</a>
	AIHA (ISO 17025, AIHA ELLAP and NLLAP)	101574	<a href="http://www.aihaaccreditedlabs.org">http://www.aihaaccreditedlabs.org</a>
Dietary Supplements	AClass (ISO 17025)	ADE-1420	<a href="http://www.aclasscorp.com">http://www.aclasscorp.com</a>



## ANALYTICAL REPORT

Workorder: **34-1409156**

Client: North Wind, Inc.

Project Manager: Kevin W. Griffiths

### Result Symbol Definitions

MDL = Method Detection Limit, a statistical estimate of method/media/instrument sensitivity.

RL = Reporting Limit, a verified value of method/media/instrument sensitivity.

CRDL = Contract Required Detection Limit

Reg. Limit = Regulatory Limit

ND = Not Detected, testing result not detected above the MDL or RL.

< This testing result is less than the numerical value.

\*\* No result could be reported, see sample comments for details.

### Qualifier Symbol Definitions

U = Qualifier indicates that the analyte was not detected above the MDL.

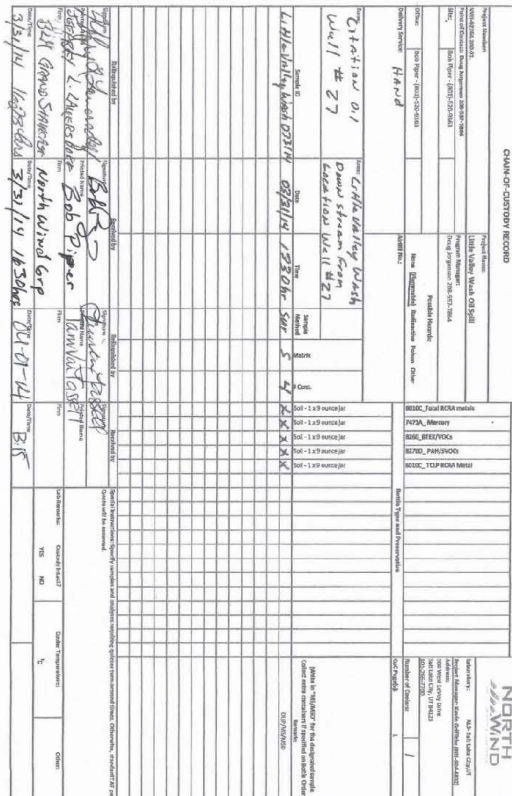
J = Qualifier indicates that the analyte value is between the MDL and the RL. It is also used to indicate an estimated value for tentatively identified compounds in mass spectrometry where a 1:1 response is assumed.

B = Qualifier indicates that the analyte was detected in the blank.

E = Qualifier indicates that the analyte result exceeds calibration range.

P = Qualifier indicates that the RPD between the two columns is greater than 40%.







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**MEMO**

To:  
Mark Bing, Citation Oil and Gas  
Daniel Benedict, Citation Oil and Gas

Copies:  
Ben Shoup, ARCADIS U.S.  
Bill Zahniser, ARCADIS U.S.  
Steve Perry, ARCADIS U.S.

From:  
Julie Sueker, PhD, PH, PE

Date:  
May 1, 2014

ARCADIS Project No.:  
WY002484.0001

Subject:  
Petroleum Hydrocarbon Forensics Technical Memorandum – Upper Valley Unit

ARCADIS U.S., Inc. (ARCADIS) prepared this technical memorandum (memo) on behalf of Citation Oil and Gas Corporation (Citation) to present results for soil, water, and produced oil samples collected from the Upper Valley Unit (UVU) located with the Grand-Staircase Escalante Monument and the Dixie National Forest located in Garfield County, Utah (Map 1 – in progress). A forensic-level assessment of petroleum hydrocarbons in soil and produced oil samples was conducted to evaluate compositional similarities and differences between soil samples collected from the Pet Hollow (1 sample), Bear Hollow (1 sample), and Little Valley Wash (3 samples) drainages and the produced oil and to assess the relative age and extent of oil weathering that has occurred. One surface water sample was analyzed to assess the quality of surface water in Little Valley Wash that was in direct contact with oiled sediment. Results of these assessments are summarized below and are presented in more detail in the following sections.

- **Soil and Oil Samples**

- The C3-C10 hydrocarbon (PIANO) results for the Main Battery Oil sample are consistent with a fresh (unweathered) crude oil and provide a good comparison for soil samples. PIANO results for the five soil samples demonstrated substantial (nearly complete) depletion of C3-C10 hydrocarbons. Benzene, toluene, ethylbenzene, and xylene compounds (collectively referred to as BTEX) were not detected in any soil samples. These results demonstrate that the lighter fraction of the crude oil (C3-C10) in the five soil samples is weathered.

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- The Full Scan GC/MS results for each soil sample show similar and consistent patterns. The Pet Hollow and Bear Hollow soil sample results indicate the >C10 fraction of oil in these samples is weathered. The Little Valley Wash soil sample results indicate the >C10 fraction of oil in these samples is moderately weathered.
  - The difference in weathering patterns for the Little Valley Wash soil samples compared with the Pet Hollow and Bear Hollow soil samples may be explained by historical spill response practices including burial of oil-affected soil. Burial of oil-affected soil in the Little Valley Wash, either by spreading of dirt during a spill response or by natural processes in this active alluvial wash, may have resulted in retardation of the weathering of oil compared with Pet Hollow and Bear Hollow where oil appeared to have been more exposed and subject to various weathering processes.
  - Although it is not possible to assign a specific age of release for oil in Little Valley Wash, multiple lines of evidence, including petroleum hydrocarbon forensic results, recent visual observations by a number of individuals, and anecdotal information regarding historical spill response practices, suggest that the vast majority of oil in Little Valley Wash is not of recent origin and is instead related to an historical release or releases that occurred early in the 42-year history of oil production at the head of the Little Valley Wash drainage.
  - Based on assumptions provided below, the estimated volume of oil released several decades ago to Little Valley Wash is approximately 550 barrels (bbls).
- **Surface Water Sample**
    - The Little Valley Wash Surface Water sample results demonstrate that concentrations of Total dissolved solids (TDS), BTEX compounds, and Total Petroleum Hydrocarbons – Diesel Range Organics (TPH-DRO) are below human health standards and screening values. The TPH-DRO detected in the Little Valley Wash Surface Water sample is comprised of weathered oil.

### Soil and Oil Samples

On April 3 and 4, 2014, Tyler Cox, Bureau of Land Management Natural Resource Specialist (BLM NRS) and ARCADIS personnel Randolph Moses and Max Moran collected sample splits for three (3) soil samples from Little Valley Wash and one soil sample from Pet Hollow (Figure 1). Each soil sample was collected into four 8-ounce glass jars and the oil sample was collected into a 40-milliliter (mL) glass vial. Samples were stored and shipped on ice under chain of custody procedures. In addition, one sample of produced oil was collected from the main battery. On April 8, 2014, Gary Harding, Citation, collected one soil sample from Bear Hollow. Sample designations are:

- PH-HS-1 – Pet Hollow soil sample collected from a seam of oil-affected soil approximately 3 feet below the top of bank

- Bear Hollow – Bear Hollow Soil sample collected from upper portion of the hollow below point of historic oil spill
- LV-OS-I1 – Little Valley Wash soil sample collected from within the middle portion of oil-affected soil
- LV-OS-I1C – Little Valley Wash soil sample collected from the surface of oil-affected soil
- LV-OS-SEEP – Little Valley Wash soil sample collected from location with oil seeping to surface of oil-affected soil
- Main Battery Oil Sample – sample of produced oil collected directly from the main battery

Samples were submitted to Zymax Forensics (Zymax), located in Escondido, California<sup>1</sup> for the following analyses:

- C3-C10 (gasoline-range hydrocarbons) by high resolution gas chromatography mass spectrometry (GC/MS) [equivalent to USEPA Method 8260 modified to focus on petroleum hydrocarbon compounds]. This analysis, often referred to as PIANO analysis, identifies approximately 120 compounds in the gasoline range (C3-C10)<sup>2</sup> for paraffin, isoparaffin, aromatic, naphthene, and olefin (PIANO) compound classes. Data are reported as concentrations for comparing compositional similarities between samples. Data can be used to evaluate relative extent of weathering of the lighter hydrocarbon compounds. The produced oil sample was extracted and analyzed in the same manner as the soil samples to allow direct comparison of analytical results.
- Full Scan GC/MS [equivalent to USEPA Method 8270 modified to focus on petroleum hydrocarbon compounds]. This analysis provides chromatogram distributions of the following compound classes: alkanes (paraffins), iso-alkanes (isoparaffins), alkylbenzenes, alkylcyclohexanes, polycyclic aromatic hydrocarbons (PAHs), and biomarkers in the C7+ range. The distribution of compounds in the various compound classes provides information on the similarities and differences between samples and the relative extent of weathering. The produced oil sample was extracted and analyzed in the same manner as the soil samples to allow direct comparison of analytical results.
- TPH diesel range organic (TPH-DRO) by USEPA Method 8015. This analysis was conducted to assess the concentration of oil in soil.

Laboratory reports are attached.

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<sup>1</sup> Zymax Forensics, 600 S. Andreasen Drive, Suite B, Escondido, CA 92029. Point of contact: Dr. Alan Jeffrey 760 781-3338.

<sup>2</sup> C3 indicates a hydrocarbon compound containing three carbon atoms.



### ***Petroleum Hydrocarbon Forensic Methods***

Environmental forensics is a systematic and scientific evaluation of physical, chemical, and historical information for the purpose of developing defensible scientific and legal conclusions regarding the source or relative age of a release of constituents of interest (COIs) into the environment. Environmental forensics includes an array of analytical and data evaluation techniques that can be used to distinguish materials with similar properties. Petroleum hydrocarbon forensics refers herein specifically to the study of petroleum hydrocarbons in the environment.

Unrefined and refined petroleum hydrocarbon products, including crude oil, are complex mixtures containing hundreds or thousands of individual hydrocarbon compounds. The exact composition of petroleum hydrocarbon products may vary due to a number of factors including the original oil source and subsequent refining. Changes in the composition of petroleum hydrocarbons also occur due to weathering processes, including volatilization, solubilization, and biological degradation, that take place after a product has been released to the environment.

Petroleum hydrocarbon forensics, or “fingerprinting,” is an important tool in evaluating the composition of petroleum hydrocarbons in light non-aqueous phase liquids (LNAPL), soil, and water at environmental sites. Several analytical techniques have been developed to fingerprint petroleum hydrocarbons, including the PIANO analysis for light hydrocarbons (C3-C10) and Full Scan GC/MS analysis for heavier petroleum constituents (C7+). These analyses are important tools for identifying the composition and extent of weathering of petroleum hydrocarbons in environmental media.

### ***PIANO Analysis Results***

PIANO results for the soil samples were evaluated graphically to illustrate the distribution of PIANO compounds in each sample. Soil sample PIANO bar charts are provided on Figures 1 through 5. These figures show the distribution of PIANO compound concentrations by compound class (paraffin compounds in orange, isoparaffin compounds in blue, aromatic compounds in purple, naphthene compounds in green, and olefin compounds in dark red) with lighter compounds in a compound class present towards the left-hand side of each compound class group and heavier compounds towards the right of each group. Each figure shows the PIANO bar chart for a soil sample in the upper half of the figure and the PIANO bar chart for the Main Battery Oil Sample on the bottom half of the figure for comparison.

The relative contribution of PIANO constituents and their carbon numbers to the total PIANO pool provides important insight into the type and degree of weathering of a petroleum hydrocarbon sample. Fresh gasoline, for example, is characterized by a prevalence of lighter compounds (C3 to C8), with paraffins and isoparaffins dominating the C3 to C5 carbon classes and aromatics dominating C6 to C8 carbon classes. For each PIANO class, lighter compounds (compounds with lower carbon numbers) tend to be more soluble than heavier compounds and will weather more quickly. Furthermore, paraffins and

isoparaffins have less complex molecular structures and will weather more rapidly than aromatics, naphthenes, and olefins.

Results for the PIANO analysis are summarized as follow:

- Main Battery Oil Sample (Figure 1) – this produced oil sample is characterized by detected concentrations of most PIANO compounds at concentrations ranging from less than the laboratory practical quantitation limit (PQL) of 15 milligrams per kilogram (mg/kg) to a maximum concentration of 2,375 mg/kg. The total concentration of reported PIANO compounds was 36,068 mg/kg.
- Pet Hollow Soil Sample (Figure 2) – two C3-alkylcyclohexanes (naphthene) compounds were detected at concentrations of 0.331 and 0.375 mg/kg, slightly above the PQL of 0.3 mg/kg. Total concentration of reported PIANO compounds was 0.706 mg/kg.
- Bear Hollow Soil Sample (Figure 3) – PIANO compounds were not detected at concentrations above the PQL of 0.3 mg/kg.
- Little Valley Wash LV-OS-I1C – two alkane compounds (decane and undecane) and one aromatic compound (1-methylnaphthalene) were detected at concentrations ranging from 0.32 to 0.65 mg/kg. Total concentration of reported PIANO compounds was 1.49 mg/kg.
- Little Valley Wash LV-OS-I1 – two alkane compounds (decane and undecane) and several aromatic compounds were detected at concentrations ranging from 0.34 to 1.06 mg/kg. Total concentration of reported PIANO compounds was 7.87 mg/kg.
- Little Valley Wash LV-OS-SEEP – three alkane compounds (nonane, decane, and undecane) and two aromatic compounds (1-methylnaphthalene and 2-methylnaphthalene) were detected at concentrations ranging from 0.36 to 0.65 mg/kg. Total concentration of reported PIANO compounds was 2.52 mg/kg.

In summary, the PIANO results for the Main Battery Oil sample are consistent with a fresh (unweathered) crude oil and provide a good comparison for soil samples. PIANO results for the five soil samples demonstrated substantial depletion of C3-C10 hydrocarbons. The maximum detected compound concentration was 1.06 mg/kg; less than four times higher than the PQL of 0.3 mg/kg and well below the PQL for the oil sample. Benzene, toluene, ethylbenzene, and xylene compounds (collectively referred to as BTEX) were not detected in any soil samples. These results demonstrate that the lighter fraction of the crude oil (C3-C10) in the five soil samples is weathered.

#### **Full Scan GC/MS Analysis Results**

As described above, the Full Scan GC/MS analysis provides chromatogram distributions for several compound classes. GC/MS chromatograms include the gas chromatography column elution time (minutes) on the x-axis and the detector response in millivolts (mV) on the y-axis. The curve produced is referred to as a CG-trace. Individual compounds that are present at higher concentrations will appear as discrete peaks on the GC trace while compounds that are lower in concentration are included within the

unresolved complex mixture (UCM) curve below the trace (referred to as a UCM “hump”). The UCM hump occurs because there are too many compounds eluting from a GC column at the same time for the detector to resolve. Lighter compounds elute more quickly and appear towards the left of the GC/MS trace while heavier compounds appear towards the right. As with the PIANO analysis, lighter compounds will tend to weather more rapidly than heavier compounds.

Soil sample Full Scan GC/MS chromatograms were compared to the Main Battery Oil sample chromatograms for the following compound groups:

- Total Ion Chromatograms (Figures 6 through 10) includes all compounds in a sample.
- $m/z^3$  85 chromatograms (Figures 11 through 15) show normal alkanes (paraffins) detected in a sample.
- $m/z$  113 chromatograms (Figures 16 through 20) show isoalkanes and isoprenoids (isoparaffins) detected in a sample.

GC/MS chromatograms for other compound classes are provided in the attached laboratory reports.

The GC/MS chromatograms for each sample show similar and consistent patterns. The Pet Hollow and Bear Hollow samples show limited discrete peaks on the total ion chromatograms and depletion or absence of alkanes and isoalkanes relative to the Main Battery Oil sample. These results indicate the oil in these samples is weathered. For the Little Valley Wash soil samples, the total ion chromatograms show discrete peaks starting at approximately 30 to 35 minutes while the Main Battery Oil sample total ion chromatogram shows discrete peaks starting at the left hand side of the GC/MS trace (10 minutes). The alkane and isoalkane GC/MS traces show patterns similar to the total ion GC/MS trace. These results demonstrate that lighter hydrocarbon compounds in the Little Valley Wash soil samples are depleted relative the Main Battery Oil sample indicating the oil in the Little Valley Wash soil samples is moderately weathered.

The difference in weathering patterns for the Little Valley Wash soil samples compared with the Pet Hollow and Bear Hollow soil samples may be explained by historical spill response practices. A statement provided by Greg Christenson, BLM, indicates that deposits of oil were present in Little Valley Wash in 1980 when Mr. Christenson's employment with BLM began. Doug Powell worked in the Kanab BLM from 1998 to 2009 and recalled past reports of old oil within some of the drainages east of the Upper Valley Field, *“from what I can remember, it was brought to the BLMs attention and I believe I went out with someone and visited the site. I believe at that time, it was much more obscure and more covered/buried. This was confirmed from someone that I spoke with that looked at past aerial photos. I vaguely remember*

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<sup>3</sup>  $m/z$  is the mass (m) to ion charge (z) ratio. Different compound classes have characteristic  $m/z$  values.

*that it might have been a little soft and somewhat odorous, but very intact and not environmentally unstable.”* Jerry Taylor, currently Mayor of Escalante, recalled working on oil remediation in the early 1970s as summer work for a construction company contracted to do clean up for the Upper Valley Field. Mr. Taylor reported that between 1971 and 1973 he worked spreading dirt and burning pits, the then BLM-standard treatment for oil spills.

Burial of oil-affected soil in the Little Valley Wash, either by spreading of dirt during a spill response or by natural processes in an active alluvial wash, would result in retardation of the weathering of oil compared with Pet Hollow and Bear Hollow where oil appeared to have been more exposed and subject to various weathering processes. Although it is not possible to assign a specific age of release for oil in Little Valley Wash, multiple lines of evidence, including petroleum hydrocarbon forensic results, recent visual observations by a number of individuals (see Summary Report, Little Valley Wash Spill), and anecdotal information described in the previous paragraph, suggest that the vast majority of oil in Little Valley Wash is not of recent origin and is instead related to a release or releases that occurred early in the 42-year history of oil production at the head of the Little Valley Wash drainage.

#### **TPH-DRO Results and Released Oil Volume Estimate**

Soil sample TPH-DRO concentrations ranged from 33,000 mg/kg for the Bear Hollow soil sample to 73,000 mg/kg for the Little Valley Wash LV-OS-SEEP soil sample (Table 1). The TPH-DRO results were used to estimate a potential volume of oil released to Little Valley Wash with the following assumptions:

- Length (l) of oil-affected soil in the channel is 10,560 feet (2 miles)
- Average width (w) of oil-affected soil in the channel is 4 feet
- Average thickness (d) of oil-affected soil in the channel is 0.5 feet
- Volume of oil-affected soil ( $v_s$ ) =  $l * w * d$
- Bulk density ( $\rho_b$ ) of soil is 1.5 kilograms per liter (kg/L)
- Mass of oil-affected soil ( $m_s$ ) =  $v_s * \rho_b$
- Initial concentration of oil in soil ( $C_o$ ) at time of release was 120,000 mg/kg (12%) based on the average Little Valley Wash soil TPH-DRO concentration (~60,000 mg/kg) multiplied by 2 to account for mass loss due to weathering and for heavier compounds (>C28) not included in the TPH-DRO analysis
- Mass of oil ( $m_o$ ) in oil-affected soil =  $m_s * C_o$
- Initial density of produced oil ( $\rho_o$ ) is 0.81 kg/L
- Volume of oil released into Little Valley Wash ( $v_o$ ) =  $m_o * \rho_o$

Following these assumptions and applying appropriate unit conversion results in an estimated volume of oil released several decades ago to Little Valley Wash of approximately 550 bbls.



### Little Valley Wash Surface Water

One surface water sample was collected by ARCADIS personnel from Little Valley Wash on April 4, 2014 from slow moving water that was flowing on top of oil-affected soil. The sample was collected into a 16-ounce plastic bottle and was submitted to Zymax under chain of custody protocol for analysis of total dissolved solids (TDS), TPH-DRO, and BTEX. The sample was collected opportunistically during the April 4, 2014 media event into an available sample container. The hold time for analyses was exceeded prior to shipment of sample to the lab. Based on use of non-standard sample container and exceedance of hold time, sample results should be considered for screening purposes only. Sample results (Table 2) were compared to Utah standards and criteria and are summarized as follows:

- TDS was detected at a concentration of 1,860 milligrams per liter (mg/L or parts per million [ppm]) which is less than the Drinking Water Standard of 2,000 mg/L (Utah Administrative Code Standards – Rule R309-200).
- BTEX compounds were not detected. Laboratory reporting limits for the BTEX compounds were at least one order of magnitude less than Drinking Water Standards.
- TPH-DRO was detected at a concentration of 0.41 mg/L. The Leaking Underground Storage Tank Initial Screening Value for TPH is 1.0 mg/L (Utah Department of Environmental Quality).

The Little Valley Wash Surface Water sample results demonstrate that concentrations of TDS, BTEX compounds, and TPH-DRO are below human health standards and screening values (Table 2).

The Little Valley Wash Surface Water sample TPH-DRO chromatogram generated from the TPH-DRO analysis was compared with the TPH-DRO chromatogram for the Laboratory Diesel Standard Reference Material (Figure 26). The Laboratory Diesel Standard Reference Material chromatogram shows compounds ranging from approximately C12 through C28 with discrete peaks present. These characteristics are typical for a fresh diesel fuel. The Little Valley Wash Surface Water sample TPH-DRO chromatogram shows compounds ranging from approximately C16 through C35. Discrete peaks are not observed for the surface water sample. These results indicate that TPH-DRO detected in the Little Valley Wash Surface Water sample is comprised of weathered oil.

Table 1. Soil Analytical Results for TPH as Diesel

		TPH as Diesel (EPA 8015BM)			
Sample ID	Sample Date/Time	Result (mg/kg)	Reporting Limit (mg/kg)	Qualifier <sup>1</sup>	Laboratory Work Order No.
Pet Hollow PH-HS-1	4/4/2014 @ 9:05	38,000	500	HD	14-04-0685
Bear Hollow	4/8/2014 @ 10:00	33,000	500	HD	14-04-1259
Little Valley Wash LV-OS-I1C	4/3/2014 @ 14:00	42,000	500	HD	14-04-0685
Little Valley Wash LV-OS-I1	4/3/2014 @ 14:00	57,000	500	HD	14-04-0685
Little Valley Wash LV-OS-SEEP	4/3/2014 @ 16:40	73,000	500	HD	14-04-0685

Notes:

<sup>1</sup>HD - the chromatographic pattern was inconsistent with the profile of the reference fuel standard

mg/kg - milligrams per kilogram

**Table 2. Little Valley Wash Surface Water Sample Results and Comparison to Utah Administrative Code Standards and Leaking Underground Storage Tank Initial Screening Values**

Little Valley Wash Surface Water Sample Results					Utah Administrative Code Standards			Utah DEQ
Analyte	Method	Units	Sample Date 4/4/2014		Rule R309-200 Drinking Water Standards <sup>1</sup>	Rule R317-2 Surface Water Standards <sup>2,3</sup>		Leaking Underground Storage Tanks <sup>8</sup>  Initial Screening Values
			Result	Qualifier <sup>3</sup>		Agricultural Uses <sup>4</sup>	Human Health Criteria (Consumption) <sup>5</sup> Class 1C - Water and Organism <sup>7</sup> Class 3A, 3B, 3C, 3D - Organism Only	
Total Dissolved Solids	SM2540C	mg/L	1,860	BU	2,000	1,200 <sup>6</sup>	NA	NA
Total Petroleum Hydrocarbons - Diesel Range	EPA 8015B	mg/L	0.41	HD, ET	NA	NA	NA	1
Benzene	EPA 8260B	mg/L	<0.0005	BU, ET	0.005	NA	0.0022	0.005
Ethylbenzene	EPA 8260B	mg/L	<0.001	BU, ET	0.7	NA	0.53	0.7
Toluene	EPA 8260B	mg/L	<0.001	BU, ET	1	NA	1	1
p/m-Xylenes	EPA 8260B	mg/L	<0.001	BU, ET	10	NA	10	10
o-Xylenes	EPA 8260B	mg/L	<0.001	BU, ET	10	NA	10	10

**Notes:**

<sup>1</sup> Utah Administrative Code, Rule R309-200 Monitoring and Water Quality: Drinking Water Standards, effective March 1, 2014. <http://www.rules.utah.gov/publicat/code/r309/r309-200.htm>, accessed on April 18, 2014.

<sup>2</sup> Utah Administrative Code, Rule R317-2 Standards of Quality for Waters of the State, effective March 1, 2014. <http://www.rules.utah.gov/publicat/code/r317/r317-002.htm#T9>, accessed April 18, 2014.

<sup>3</sup> Tributaries to Lake Powell, including Little Valley Wash, are classified as Class 2B, Class 3B, and Class 4 water as follows:

Class 2B -- Protected for infrequent primary contact recreation. Also protected for secondary contact recreation where there is a low likelihood of ingestion of water or a low degree of bodily contact with the water.

Examples include, but are not limited to, wading, hunting, and fishing.

Class 3B -- Protected for warm water species of game fish and other warm water aquatic life, including the necessary aquatic organisms in their food chain.

Class 4 -- Protected for agricultural uses including irrigation of crops and stock watering.

<sup>4</sup> Table 2.14.1 Numeric Criteria for Domestic, Recreation, and Agricultural Uses. No values provided for domestic source or recreation.

<sup>5</sup> Table 2.14.6 List of Human Health Criteria (Consumption).

<sup>6</sup> Site-specific standards for total dissolved solids ranged from 1,430 mg/L to 9,700 mg/L indicating range of potential background TDS concentrations is higher than Agricultural Uses value.

<sup>7</sup> Values not applicable for Class 2B, Class 3B, and Class 4 water, but are shown for comparison.

<sup>8</sup> Table 1-2 Initial Screening Values. Guidelines for Utah's Corrective Action Process for Leaking Underground Storage Tanks, Third Edition Final Draft, Updated November 2010. <http://www.undergroundtanks.utah.gov/docs/correctiveActionProcessGuide.pdf>, accessed April 18, 2014.

<sup>9</sup> Sample was collected opportunistically during the April 4, 2014 media event using available sample container. Analysis hold times were exceeded prior to sample shipment to laboratory. Results should be considered useful for screening purposes only.

BU - sample analyzed after holding time expired

DEQ - Department of Environmental Quality

ET - sample was extracted past end of recommended maximum holding time

HD - the chromatographic pattern was inconsistent with the profile of the reference fuel standard

NA - not applicable

mg/L - milligrams per liter - equivalent to parts per million (ppm)

<0.0005 - indicates compound was not detected, numeric value is the laboratory reporting limit in mg/L

**Appendix B: Production Inspection – April 2-3, 2014. Reports submitted by Jeffrey Brown, PET, BLM-Monticello and Tyler Cox, NRS, BLM-Price.**

Citation Oil & Gas Corporation

Upper Valley Unit #8910081780

Case Number UTU-630380

Production Inspection – April 2-3, 2014

The Upper Valley Unit (UVU) includes 29 active wells, 18 producing oil wells (POW), 9 water injection wells (WIW), one water supply well (WSW) and one temporary abandoned (TA) well. The BLM administers the mineral estate for the UVU and the surface for 5 POW (#12, 18, 19, 21 & 27) and one WIW (#23). The remainder of the wells are on surface administered by the United States Forest Service (USFS). The first well was drilled in May, 1962 and the last well was completed in 1986. Citation Oil and Gas Corporation purchased the oil field from Tenneco Oil Company, effective September 1, 1987. The UVU has produced over 28 million barrels of oil to date.

The majority of the well and facility signs are in good condition, complete and correct. There are a few that are barely legible, some that do not show current operator name and one missing. The operator has ordered new signs for the entire field. The access roads are in good to poor condition. The operator has maintained the access road in the past, but the USFS ordered the operator to discontinue road grading. *[Susan Baughman, USFS reviewed this report, and has supplied this correction: The operator maintains approximately 32 miles of roads within the lease including access to the lease. A culvert along the Liston Flat road is in need of replacing and the USFS has informed Citation Oil that they have a contractor who will be replacing that culvert this spring. The USFS has requested Citation to discontinue road grading or to stop blading any roads.]* Well pads are generally clean and the wellheads are fenced. Electric service is available at each well. The oil wells contain electric subsurface pumps and each is equipped with a Murphy switch that has the ability to shut-in the well due to low/high pressure. A few minor housekeeping issues were noted and these will be addressed in the recent environmental report to be submitted by the Natural Resource Specialist. Adjacent to many of the well pads are water catchments that provide water for livestock and wildlife. Most of the pipelines are buried along the access roads and use cathartic [*cathodic*] protection. There are also a few rights of ways for other segments of the pipelines and power lines.

**Onshore Oil & Gas Order #3 - Site Security & 43 CFR 3162.7-5.**

Each facility was inspected to ensure compliance with the requirements for Site Security. The inspections found that operations and record keeping meet or exceed the applicable minimum standards. No violations found.

Sales Terminal - T. 37 S., R. 1 W., Sec.2, NWNW.

The facility identification sign is installed on the fence around the oil tanks. The sign is complete and correct but is barely legible. The operator has a new sign ordered. A permanent marker was used to restore the information on the sign during the interim. The entire facility is fenced and gated. There are (4) 5000 barrel oil storage tanks (#1,2,3 & 4) surrounded by an adequate earthen containment. Tank #1 has been completely disconnected from



production/sales and is no longer available for use. Tank #3 is connected to production/sales but has not been used for years. All oil from the UVU is transported from the satellite batteries tanks to the sales terminal tanks #2 & 4 via buried pipelines. The tanks are connected through common plumbing, fill line valves and sales valves. These valves are always in the open position, therefore the fluid level in the tanks equalizes. The system used here is known as a closed system. A closed system does not require the fill or sales valves to be sealed because there is no access to production other than through the Lease Automatic Custody Transfer (LACT) meter. All other appropriate valves were found to be effectively sealed in the closed position. We recorded seal numbers from the tanks and the LACT meter components. We then compared these seal numbers to the operators seal record. We found the operators seal records correct and complete. The regulations require the operator to maintain such records for at least 6 years, the records maintained at the field office exceed this requirement. Site security diagrams are maintained at the field office and meet the minimum standards.

#### **Onshore Oil & Gas Order #4 - Oil Measurement & 43 CFR 3162.7-2**

The operator meets the requirements for oil measurement. No violations found.

The LACT meter components are not complete. The missing components are the BS&W monitor and diverter valve. A variance has been granted for the absent components (4/1990). There are no by-passes around LACT meter.

Obtained copies of the LACT run ticket for January, 2014 oil sales and the pumper's daily log for same. Checked the production and sales volumes reported on the Operator's Oil & Gas Report (OGOR) for January 2014. Found reporting to be accurate. Oil sold through the LACT for 1/14 was 13,521.5 barrels of oil (gross). Gross volume x the composite meter factor (.9976)-BS&W (6.7 bbls) = net sales 13,482 bbls. Total net oil sales reported are the same (attached).

The pumper gauges tanks #2 & 4 daily and records the gauges. The daily pumper gauges for January 2014 are attached. BLM gauged tanks #2 & 4 to obtain a daily oil production rate during 4/2-3/2014 and found the rate to be reasonable when compared to the pumper's daily log and reported monthly production volumes. BLM tank gauge for 24 hour rate was 441 bopd and average rate for 1/14 was ~438 bopd. A three year average for the field was calculated at 426 bopd (attached).

The LACT meter is proved quarterly and the proving report is submitted to the BLM the same day. At least 6 runs are made within tolerance (.0005) and 5 of the runs along with the correct correction factors are used to compute the composite meter factor (requirements meet).

The first of each month a representative oil sample is taken from the sample pot on the LACT unit and thoroughly mixed. The sample is then checked to determine the quality, API gravity and BS&W content. A temperature averager is used to obtain the average oil sales temperature.

Oil is sold daily through the LACT meter and transported by truck to the refinery.

#### **Onshore Oil & Gas Order #5 – Gas Measurement & 43 CFR 3162.7-3**

Since no gas is measured in the UVU this order does not apply. Gas produced is estimated because volumes produced within the UVU are too small to measure. Average gas is estimated between 0 – 3 mcf/d per oil well. All gas is reported as oil well gas vented. Approval for venting was granted 9/1998.

## **Onshore Oil & Gas Order #6 – Hydrogen Sulfide**

The operator meets the operating standards under Order 6. No violations identified.

The operator has installed hydrogen sulfide warning signs that are within 50 feet of facilities. Windsocks are installed at all production facilities. Where stairs are attached to tanks the access is chained off and signed Danger Poison Gas Hydrogen Sulfide. Biocides are injected semi-annually to reduce hydrogen sulfide.

## **Onshore Oil & Gas Order #7 – Disposal of Produced Water**

The UVU produces an average of 28,000 barrels of water per day. All produced water is injected into the 9 water injection wells throughout the UVU. Injection is generally the preferred method for produced water disposal. The State of Utah has authority over this operation and requires the operator to conduct mechanical integrity tests periodically.

### **Notice to Lessees (NTL-3A) Reporting of Undesirable Events**

There have been recent releases due to pipeline failures within the past few years. The operator has stated that volumes lost were less than the reporting threshold (10 barrels or more). No Incidents of Noncompliance have been issued since 6/4/12 for failure to report an undesirable event. Since the recent releases that have occurred have been cleaned up before we can document and estimate an approximate volume we do not have sufficient evidence the volumes are reportable. A written order has been issued that requires the operator to report all spills regardless of volume.

Tyler Cox, Natural Resource Specialist, Report of Field Inspection

On April 2<sup>nd</sup> and 3<sup>rd</sup>, 2014 I visited all of the active locations within Citation Oil & Gas Corporation's (Citation) Upper Valley Unit except for well 19. I was not able to locate this well within the timeframe I was in the field. The two PETs did make it this location and have noted them in their reports.

All of the locations were generally in good condition. There were some minor issues on most of the locations, such as excess materials on site and locations/access roads needing maintenance. The morning of the 3<sup>rd</sup>, we had a conference call with involved parties with the project. Citation was involved with that call. I made a comment about the general housekeeping in that call. By the time I made it out to the production field, they had already started cleaning up the issues.

Each of the locations would be improved by initiating interim reclamation. I am aware that this was not required with any of their surface use plans, since they predate those requirements. If the agencies could work with the company to get it started, I believe that it would benefit everyone in the end. I witnessed area that had been left alone, and the vegetation moved in on its own. I believe that if the company was able to recontour some unused sections of the locations and did not impact these areas any more, that revegetating the areas would be fairly simple. Pictures of the locations were taken.

## Appendix C: GSENM Field Resource Reports

Field Team Members: Terry Tolbert, Wildlife Biologist, Botany, GSENM; Raymond Brinkerhoff, Botanist, GSENM; Jason Bybee, Rangeland Management Specialist, Botany, GSENM; Brett Palmer, Range Technician, GSENM; Amber Hughes, Botanist, GSENM; Nephi Noyes, Rangeland Management Specialist, Soils, GSENM; Sean Stewart, Rangeland Management Specialist, Botany, GSENM; Cameron McQuivey, Wildlife Biologist, GSENM; Alan Bate, Rangeland Management Specialist, Forestry, GSENM.

### *Upper Valley Field and Little Valley Wash, April 3, 2014*

Amber Hughes, Botanist, GSENM

The five of us (Tolbert, Brinkerhoff, Bybee, Palmer, and Hughes) inspected three well sites, #11, #27, #33, as well as Little Valley Wash for oil spillage. All of my photos, (AHughes) can be found on the Z:\Science Program\Hughes folder.

There had been a spill at site #11 where there is evidence of oil in the pond just below the pump. There is also evidence that they burned the oil spill as some of the trees nearby have been blackened by soot.

At site #33 there apparently had been previous spills but they have been covered up by soil, there is a dry pond with an overflow into the canyon below. I didn't find any evidence of a recent spill. We were asked to look at this site closely for damage to surrounding vegetation. At this point in time I couldn't see any damage to vegetation but most everything is dormant. A site visit during the summer growing months would be appropriate to more effectively observe the site.

At site #27 you can see where a recent pipe had been broken in or near the road. Evidence of oil is in the run off area next to the road where just before getting to the site it crosses and goes down into Little Valley Wash/Canyon.

While hiking in the said canyon you can see evidence of fairly new oil on vegetation, trees, and rocks. This oil appears fresh, and has a strong odor and in many places has an oily sheen to it. There was a side canyon that was near/below the pad that showed an oil spill that looked older; the oil didn't appear as the description above. Hiking the remainder of the canyon showed more of the newer looking oil than the old oil as it looked in that side canyon.

### *Horse Springs Canyon, April 7, 2014*

Nephi Noyes

Brett Palmer and myself (Nephi Noyes) rode horses from well 21 down Horse Spring Canyon. There is some old oil in the wash starting at the well and sporadic evidence for about 3/4 of a mile down the wash. It is having no detrimental effects on the ecosystem in the wash or the surrounding area. The oil is very old and resembles asphalt. In talking to some of the elderly people that were raised in Escalante, they stated that the reason the wells were drilled in the area in the first place, was that oil was seeping out of the ground into the washes. *[Note: There is no geological report which would indicate that oil was ever seeping out of the ground in Little Valley Wash; older residents may be confounding stories of oil seeps further down the strike which led to the development of the Upper Valley Field with seeps in the local area itself. There are coal seams visible in the banks of Little Valley Wash which may also have had an impact on what people remember about this region.]*

*Pet Hollow April 7, 2014*

Terry Tolbert

I took my truck up to the BLM/Forest Service boundary and went up to the Upper Valley Unit #1 well pad. There had been a spill there sometime in the past that entered two different drainages and ran into Pet Hollow main drainage. There are some stretches of oil in the bottom of the drainages in the more level spots but it is mostly gone where the gradient is steeper. No resource damage was evident. There was soil crust around some of the remnants of the old oil spill. No signs of trees being affected by the old oil. Along the main Pet Hollow drainage there was evidence of an old spill, probably the one from the oil well mentioned above, and some areas where it has been mixed with gravel with heavy equipment. There is about a 3 acre area where the oil had been worked into the gravel and mounds were still there. That area has shrubs and grass and there were a few twenty foot ponderosa pine trees growing there. There are some good cross sections of the asphalt layer along the wash that has a layer of dirt over it about a foot thick. This spill is probably over 40 years old judging by the size of the trees growing in the areas where the oil was mixed into the gravel. Evidence of the spill goes down the canyon for a couple hundred yards and then is reduced greatly being small chunks of asphalt in the wash bottom. I have pictures if they are needed.

*Resources report for Citation oil spill unit 27 April 3, 2014*

Members of Party – Brett Palmer, Jason Bybee, Raymond Brinkerhoff, Amber Hughes, Terry Tolbert.

We hiked into the area where the spill was reported to be and proceeded to assess the resources. It was obvious that there were two separate oil flows into the drainage, one being older than the other. Some of the vegetation was completely covered with oil, some only partly. The oil did not appear to have any adverse effects on the plant vigor. There was some green grass growing up through the oil covered wash bank and new growth on the ends of the Douglas fir branches that were covered with oil during the event. There was oil mixed with sand and rocks which formed an asphalt like substance that lined the bottom of the wash. This may affect the infiltration and flow of this wash. We GPS'd the extent of the asphalt bottomed wash and it extended for approximately 2.5 miles. One pool out of several in the wash had some small bugs swimming in it. One pool had some oil film on it while the other showed no sign of oil in them. There were no apparent adverse effects associated with event on wildlife species. None were observed trapped in the oil residue and the asphalt was too hard to get an animal stuck in. The spill will have no effect on livestock grazing. I have a file of pictures and a plant list for the area available if more is needed.

*Bear Hollow, Right and Left Hand Forks*

Sean, Allan, and Brian walked approximately 2 miles down the head of these drainages. A very small amount of old residue was observed in the right fork (less than a five gallon bucket full). The left contained a considerable amount of old residue confined to the bottom of the channel. This extended onto BLM administered lands approximately 1/2 mile. According to Gary Harding (Oil Field Foreman) this is from a spill that occurred in the 1980s and cleanup/recovery efforts were overseen by the BLM and USFS. Vegetation appeared to be normal and healthy and the few areas with water (snow melt) do not have sheen or other indications that oil residue is mobile. Wildlife observed include Mule Deer, birds, and several species of butterfly.

There was no sign of recent leaks or spills in either canyon. Also there are catch ponds at the head of each drainage (USFS lands), these could be cleaned to aid in containment of any future spills.

*Canaan Creek, Drainage below Well #11 and #23, Drainage below Well #10:*

We (Jason Bybee, Cameron McQuivey) hiked approximately 2 miles down the Canaan Creek drainage



below well's 19, 25, 18. We did see some old oil that had hardened into asphalt. Some of it was still covered in cobble rock and sand which only allowed us to see a thin black layer in the sides of the wash bank. There was no visible oil on the vegetation and very little was seen on any of the exposed rock. The asphalt like substance was rock hard and very difficult to break apart. From our observations resource damage was not evident. The plants and trees in the drainage showed high vigor and appeared to be in good condition. We did take some pictures and we can get those if needed. We hiked down the drainage (no name on the map) just below well's 11 and 23. This drainage did not show any signs of oil. Also the drainage below well 17 flowed into the drainage of well's 11 and 23 and it also showed no signs of oil. We made a loop over into the drainage below well 10 and proceeded up drainage towards the well. Approximately  $\frac{3}{4}$  of a mile down from well 10 we started to see signs of the oil asphalt like substance. Some of it was also buried under the sand and rock in the wash bed. There was some that was visible on top of the sand and rock but it was very sporadic. Nothing was seen on the plants or the trees in the drainage. No resource damage was evident. The vegetation showed high vigor and appeared to be in good condition. We did take some photo's and we can get those if needed.

#### *Willow Canyon:*

Jason, Brett, Sean, walked approximately 1 mile down Willow canyon from the pour off adjacent to Citation Oil satellite facility: The only residue observed was just off the road above the pour off. Down canyon there were a couple of short (3 to 4 feet in length) segments of pipe, most likely carried down by floods. Other than that we did not observe any old residue or any sign of newer leaks or spills. This portion of Willow Canyon is very narrow (slot canyon) with some reaches only 6 to 10 feet wide in the bottom. We did not encounter any live water but did see mule deer tracks along the canyon bottom where it was accessible and noted a number of birds in the area.

Little Valley Oil Spill  
Field Notes-- M. Zweifel, 4/15/2014

Hiked to the bottom of the drainage from the access road, a steep, rocky, brushy climb.

Found heavy, old-appearing oil flow remnants (now very asphalt-like) heavy in the bottom of the wash, upstream of the mud pit.

Hiked upstream, there are also signs of a more recent flow mixed in with the older stuff—recent oil on the base of trees and some vegetation (see D-fir photo at map point #5).

Found where the oil entered the main canyon bottom (map point #6) near the upper end of the canyon. Hiked up the side drainage until I could see the powerlines (along the access road) almost overhead, but too brushy to go all the way up to the road. Again, a mix of old and a more recent flow.

Oil staining on rocks in the canyon bottom wash up to 50 cm+ deep just downstream from the above confluence, and up to 60-70 cm deep further downstream below the mud pit.

Hiked downstream and identified a second location where an oil flow entered the main canyon bottom (map point #12).

Hiked to the big turn in the canyon and then downstream to a confluence with a smaller canyon from the south. Very heavy old oil staining and asphalt all the way; did not have time to hike to the end of the flow but that has already been identified.

Hiked back to the confluence of the oldest flow (map point #12) and then followed that oil spill uphill to the original mud pit blow-out (another hard scramble up that rocky, brushy slope).

My impression is one of multiple oil spills/flows, very heavy in the past from at least the two identified locations, and more recently (<1 year) from the access road apparent pipe failure. It appears as if the most recent flow may have been over partial snow coverage and only resulted in recent staining where the oil could make it through the snow and ice (very spotty appearance of the recent stuff), but that it may have been significant in volume.

**Appendix D: Field Mapping and Event Reconstruction**

**REPORT ON OIL SPILL INVESTIGATIONS  
WELL 27- UPPER VALLEY OIL FIELD  
GARFIELD COUNTY, UTAH  
Alan L. Titus Ph.D**



4/22/2014

Bureau of Land Management  
Grand Staircase-Escalante National Monument

## Background

On April 14<sup>th</sup>, 2014, Matthew Zweifel and I visited Well 27 to investigate the extent, source, and relative age of oil spills issuing from the vicinity of that well into Little Valley and its tributaries.

We drove to the well pad via the access road and immediately began to survey the well pad itself as well as the down slope region in the vicinity of the drilling mud pit.



Figure 1. Drilling pad area for well 27. View is looking southeast.

A broad swath of oil-saturated dirt and soil was observed both coming down the east slope from the well head and out of the mud pit. Just below the rim of the mud pit on the east middle part the oil swath was 20 meters wide (north edge UTM 436434E, 4161898N; south edge UTM 436428E, 4161878N). Oil was observed at the rim of the well pad and came down the slope just east of the current well head (UTM 436361E, 4161895N). It appeared to have filled the mud pit and then breached the pit in the east center, and flowed into a ravine to the bottom of the canyon. The volume of flow must have been fairly large based on its 20 meter swath. The flow appears to be the oldest flow observed. Simple spalling and freeze thaw weathering of the rock faces on dry falls have removed much of the traces of oil (Figure 2) indicating it happened over 20 years ago, however soil in the swath is still locally heavily saturated with viscous oil.





Figure 2. Heavily weathered oil flow surface down slope from well pad. Point is located about half way down the overall slope (UTM 436513E, 4161853N). Our investigation continued on Tuesday, April 15<sup>th</sup>, in the company of Julie Sueker, a consulting hydrologist working for Citation Oil. Survey of the access road revealed that fresh oil was present about 150 meters up the road from the well pad, however, the road had recently been bladed down about 12-15 cm and much oil saturated dirt removed. Based on our estimates, the oil saturation was recent and originated from the pipeline draining well 27, about 100 meters west of a culvert in the road (culvert location UTM 436293E, 4161979N). This recent spill traveled down the south side of the road adjacent to the road cut and stained trees and vegetation bent over with snowpack (Figure 3).



Figure 3. Vegetation stained with oil along road cut in road to well 27. This was recent staining and occurred on green vegetation and branches budding out this spring. Below the culvert, vegetation was heavily spattered with oil behaving in a fairly low viscosity manner, as if it were mixed with water (Figure 4), making it clear that this was flow path of the recent spill. Oil did not appear to have flown through the culvert, but subsurface to the east and below it. Since buds of this spring's growth on shrubs are unstained (Figure 4), I would estimate this spill happened this last winter. Very little evidence of overland flow is present for this recent event, which according to the spatter patterns on trees and shrubs, occurred in the winter with about 12-15 cm of snow pack on the ground and ice on the ravine and valley bottoms (Figure 5). It would be very difficult to estimate the volume of the most recent spill; my guess would be that it would be somewhere between five hundred and one thousand gallons.

Farther down the slope of the recent flow path of it became evident that two flows had actually come down the ravine. [Note: These two flows are the older spill from the pipeline associated with Well #27, discussed in the main body of the report, and the more recent leak from the same pipeline, associated with the pipeline leak and repair of December, 2013. In this appendix, the "second flow" refers to the older event.] The second flow from a leak on the same pipeline as the most recent leak event went overland, when there was no snow or ice on the ground and left a broad, deep stain on both the rocks and the surrounding soil (Figure 6). This second flow also was of much higher viscosity and did not "spatter," but was confined entirely to the channel. Exfoliation of rock surfaces stained impregnated with asphalt from this older flow (Figure 6) indicates that while not as old as the well flow, it is probably at least 10 years old.





Figure 4. Splatter from recent low viscosity flow on branches of shrub. New growth from this year is unstained indicating it flowed within the last two years.



Figure 5. Oil stains on Buffaloberry bush (*Shepherdia rotundifolia*) indicating about 14 cm of snow cover during recent spill event. Stains start near top of pencil. Lower part of bush and branches were shielded by snow (UTM 436295E, 4162036N).





Figure 6. Asphalt impregnated rock located along same flow path in gulley as recent spill (UTM 436299E, 4162055N). Heavy exfoliation of the asphalt impregnated rock surfaces indicate it is probably more than 10 years old.



Figure 7. Oil stained Douglas fir. Staining is from recent flow and occurred in a tree well. Both the recent and historic gulley flows appear to have made it to the bottom of the slope and into the main drainage (UTM 436308E, 4162078N), although the older flow was obviously much higher volume. The more recent flow material does not appear to



extend farther down than the side canyon where the oldest flow enters the main drainage. A Douglas fir near the bottom of the ravine shows extensive oil staining from the recent flow, with the stain pattern consistent with tree well in the snow filling with oil-water mixture (Figure 7).

In the main drainage only occasional evidence can be seen of the recent spill, which is usually evidenced as small clusters of splatters on vegetation near cascades. This would suggest the drainage floor was ice covered during the event.



Figure 8. Oil stain on living Douglas Fir and down dead wood. The pattern is consistent with pooling by a higher viscosity, high volume flow, sourced from the culvert gulley (UTM 436484E, 4162064N).

In contrast to the sparse evidence for the recent flow in the drainage, there is abundant evidence for the older overland flow sourced at the culvert, which did not occur with a snowpack. The sides of the banks are extensively stained with a black pool line that indicates in places the wash flowed at least 20 cm deep with high viscosity pure oil (Figure 8). The pool line from this flow still shows liquid oil in the soil along the banks, but also shows that it is extensively weathered on the south facing bank (Figure 9).





Figure 9. Weathering of pool line on south facing log of dead and down wood indicating the greater age of the high viscosity flow (across the drainage from where figure 8 was taken).

Unfortunately I was unable to investigate any of the area down slope from the confluence with the well pad spill. However, Matt Zweifel was able to report to you on this. Since this area is well down gradient from any potential spill source it is not directly germane to the questions of how many spills are there in the vicinity of well 27 and of what age are they? There was abundant evidence that both older spills (well and older culvert) locally exist in soil and vegetation (duff) reservoirs in the subsurface. It is highly plausible that these shallow subsurface pools of still liquid oil could be remobilized each year during late summer monsoonal thunderstorms, creating small “flow” events that would be recorded downstream. Thus differentiating small remobilizations from the most recent spill could only be done with chemical age dating.

In summary, I was able to document three distinct spills. Two of decade scale age and one that happened as recently as last winter but not before the preceding winter while there about 6-10 inches of snow cover on the slopes and ice in the creek bottom. Many of the seemingly random occurrences of oil stains on trees from the recent flow can be explained by bending them over with snow pack. Downstream from the sources, it becomes more difficult to identify three events because there is almost certainly remobilization of the older spills also occurring. If I were to place the events in order; the oldest spill occurred when the well was drilled or shortly thereafter and came right out of the well head. This was a high volume flow and it went overland when there was no snow. The next flow occurred in a break in the pipeline that is buried under the access road, west of a culvert in the road. From the weathering profiles I would say the older culvert flow is younger than the well head spill, but still at least 10 years old. This is also a high volume flow and went overland when there was no snowpack. The recent flow

also came out of the buried pipeline and I'm guessing it broke about 150 meters west of the same culvert that the older pipe spill went down. [Note: the "recent flow" described here is the pinhole pipeline leak of December 2013 described earlier in this report.] Unfortunately someone has extensively graded the road since the recent spill which obliterated much of the evidence needed to locate the source. The recent flow also went down the culvert. It was considerably lower in volume, of very low viscosity, and probably diluted with water.

**Appendix E: Upper Valley Unit Documented Undesirable Events**

**Upper Valley Unit Documented Undesirable Events (BLM UTSO Records)**

(greater than 20 barrels)

<b>Date</b>	<b>Well</b>	<b>Source</b>	<b>Substance</b>	<b>Volume (barrels)</b>	<b>Into</b>	<b>Clean Up</b>
07/24/68	UV #4	Flow line	Oil and produced water	Major – no estimate of barrels	Willow Creek into Alvie Wash	Dam and burn
8/14/86		Tank	Oil	30	Emergency pit	Recovered
10/16/86		Injection line	Salt water	500	Catch pond into dry wash	
12/9/86		Tank	Oil	100	Pit	95 barrels recovered
12/11/86	UV #34	Injection line	Salt water	150	Emergency pit	Dam and bury
12/22/86		Pipeline	Oil	280		Pump and bury
1/14/87		Tank	Oil	20	Pit	10 barrels recovered
2/20/87	UV #19	Flow line	Oil and produced water	22		Contained on location
5/13/87	UV #2	Injection line	Salt water	60	Pit	Recovered
5/28/87	UV #39	Injection line	Salt water	20	Dry wash	None – diluted by rain
6/8/87	UV #39	Injection line	Salt water	20	Willow Springs	None - soaked into wash
6/16/87	UV #39	Injection line	Salt water	20	Willow Springs	None - soaked into wash
8/31/87	UV #18	Flow line	Oil and produced water	55	Canaan Creek	Dam, pump, backhoe and bury
12/15/87		Tank	Produced water	50	Willow Spring	Dam and pump
12/29/87		Injection line	Salt water	150	Pit	Recovered
1/18/88		Tank	Salt water	300	Pit	Recovered
2/1/88	UV #18	Flow line	Oil and	34	Cannan	Dam and

			produced water		Creek	pump
8/8/88		Injection line	Salt water	20		
9/6/88		Pup trailer tipped over on a curve	Oil	50	Henrieville Creek	Removed by vacuum truck and backhoe
10/19/88		Injection line	Salt water	50	Pit	45 barrels recovered
10/21/88	UV #32	Injection line	Salt water	250		
11/22/88	UV #24	Injection line	Salt water	20		None
12/6/88	UV #18	Flow line	Oil and salt water	20	Dry wash	Bury
1/3/89	UV #18	Flow line	Salt water	20		
1/11/89	UV #34	Injection line	Salt water	300	Pit	250 barrels recovered
6/23/95	UV #39	Injection line	Salt water	30	Dry wash	Soaked into wash

Unit approved June 7, 1962, by USGS and operated by Tenneco Oil Company

Draft Surface Protection and Reclamation Plan prepared in 1983 – referenced BLM Manual 1790 – Environmental Protection and Enhancement (9/9/75)

USGS oil and gas operations merged into BLM in 1984

On November 2, 1987, Citation became the operator of the unit

## Upper Valley Unit Documented Undesirable Events (USFS Dixie NF Records)

Date	Well	Source	Substance	Volume (barrels)	Into	Clean Up
Pre 1972?	#4	Broken Pump hose	Water/oil	???an 8 miles down creek"	Willow Creek	Earthen Dam to contain flow <i>Note: unsure if this was Tenneco or Sun Oil</i>
3/17/72	Satellite battery	Hose coupling in separator unit broke	Oil	?	Most was contained in the building but some flowed out into willow springs	
6/22/72	Forest Boundary T36S,R1W sec25	Overtured tank	Oil	190 bbl	Off forest near Blues	Bury
10/29/72	#14	Ruptured line	Oil	1 ½ ft wide for ½ mile length	Dry wash	
11/15/72	#2	Broken oil line	Oil	No estimate	Into ditch in Upper valley field	Recovered /pumped out
5/23/73	#15	Ruptured oil line	Oil	No estimate	Catchment basin on site	"clean up was satisfactory"
10/21/73	Between # 14 & 2	Flow line	Oil and water	5 bbl water 5 bbls oil	Dry drainage	Bury Mix oil with soil
12/17/73	Well #8	Broken oil line	Oil	5-10 barrels	Downhill	bury
01/16/74	Between #14& #2	Flow line	Oil and Water	3BBL oil 2 BBL water	pit	pumped
8/10/74	Between #15 and #4	Oil line	Oil	4 barrels from two separate leaks	Dry wash	Oil cleaned up
8/12/74	Between #10 & #11	Oil line	Oil	2 barrels		Oil cleaned up



Date	Well	Source	Substance	Volume (barrels)	Into	Clean Up
8/24/74	Main line at T36S, R1 E, sec 9	Unknown cause	oil	Small amount – no estimate of barrels	Upper Valley Creek	
10/9/74	Well # 6	Corrosion of line	Water and oil	20 bbl oil 10bbl water	Rain carried it 3 miles down the wash.	Burned
11/17/74	#6		oil	200 bbl	Retaining pond	Pumped and recovered
12/27/75	Just north of Well #10	Broken oil line	oil	100 bbl	Small drainage of Canaan Creek	Pumped and burned
5/24/76	#15	Broken nipple on 3" flowline	Oil and water	48 bbl oil 520 bbl water	Willow Springs Draw/ dry wash	Burned then mixed in sand with residue
12/24/78	T36s, R1E sec.13 SW1/4 SW1/4 <b>Well #29</b>	External corrosion on a 3" flow line	Oil Class II event	50 bbl	Emergency catchment pond contained	"will try to salvage oil if possible" Line patched
8/17/82	Near willow Springs drainage	Broken Flowline	oil	100 bbls	Down draw within 200yd. of Willow springs drainage Contained by dam	Pumped out some oil . Mixed with dirt
4/17/84	?does not indicate other than UVU	Leaking corroded pipeline	Water and oil	150 bbl oil and water	Down hillside	"implies it was taken care of
5/11/84	T36S,R1E Sec. 14 NWSW <b>Well #22</b>		Produced water	150 bbl		Sunk into ground immediately

Date	Well	Source	Substance	Volume (barrels)	Into	Clean Up
6/31/89  State and EPA notified	Leak in Bear Hollow  All pumps shut off	Leak in main oil trasmission 6" line between satellite and main battery **	oil	550 bbl	Into Bear Hollow	Pumped/ recovered 351 bbls Buried with soil In spring oil was chipped off the rocks

\*\*Cause of leak: Fifteen or twenty years ago when Tenneco originally installed the line a backhoe or caterpillar was used to bend the 6" pipe instead of using a 45 degree pipe or welding a bend. The bend had a 2-3 inch indentation in the pipe for about twelve feet. It was along this indent that the corrosion seems to have thinned the walls of the pipe where the leak occurred.

- 1) (8/23/94) Reported that 100,000 ft of line had been replaced with new fiberglass lines since 1992.

**Following page: Table of records found in State of Utah Department of Environmental Quality,  
Division of Environmental Response and Remediation**

# Reports filed with State of Utah Department of Environmental Quality, Division of Environmental Response and Remediation

REPORT No	Historic Report No	DATE REPORTED	DATE OF EVENT	POTENTIAL RESPONSIBLE PARTY	POTENTIAL RES PARTY ADDRESS	POTENTIAL RES PARTY PHONE	ADDRESS OF EVENT	HIGHWAY	MILIMARKER	NEAREST TOWN	SUMMARY OF EVENT	CHEMICAL(S) IMPACTED	NOTIFICATIONS
129	89046	7/11/1989	7/11/1989	Citation Oil & Gas	Houston, Utah	(203) 826-4545	SW 1/4 SE 1/4 Sec 36 36S 1E Garfield Co.			Escalante	Waterline to drain back Production Water 250 bbl. Pipeline rupture. Citation Oil 700 gpl.	MADE 01	MADE 02
2255	97087	3/14/1997	3/13/1997	Citation Oil and Gas Corp.	8223 Willow Place So. Housie (281) 469-9664		SW 1/4 SE 1/4 Sec 36 36S 1E Garfield Co.			Escalante	Approx. 20 barrels of produced water spilled near wellhead. The water was contained by a berm and from line tank en route to underground injection well. Release ran into a snow bank next to Canine Creek, which is red snow. Temperature at time of release was 20 degrees F. The water was contained by snow bank adjacent to creek. Impacted snow bank was cleaned up by Citation Oil personnel.		
4704		11/27/2002	11/26/2002	Citation Oil and Gas c/o Robert Eye		435-790-4406	SW 1/4 of SW 1/4 of Sec. 8, T7S, R24E, 34 Base			0 Red Wash	At the Walker Battery 1 Injection Facility a by pass line blew due to external corrosion. This lead to 500 barrels of produced water and 10 barrels of oil being released into the ground. The water was unrecoverable. The water was contained by a berm and from line tank en route to underground injection well. Release ran into a snow bank next to Canine Creek, which is red snow. Temperature at time of release was 20 degrees F. The water was contained by snow bank adjacent to creek. Impacted snow bank was cleaned up by Citation Oil personnel.		
7409		5/19/2009	5/19/2009	Unknown			UTM: N418032N; E384225E Lat 37.762287 Long 112.336652			0 Pangutich	At the Walker Battery 1 Injection Facility a by pass line blew due to external corrosion. This lead to 500 barrels of produced water and 10 barrels of oil being released into the ground. The water was unrecoverable. The water was contained by a berm and from line tank en route to underground injection well. Release ran into a snow bank next to Canine Creek, which is red snow. Temperature at time of release was 20 degrees F. The water was contained by snow bank adjacent to creek. Impacted snow bank was cleaned up by Citation Oil personnel.		
8507		5/4/2012	5/4/2012	Citation Oil & Gas			Upper Valley Oil Field			PANGUTICH	Oil	DWQ, Jim Robinson 5/4/2012 10:14	Southwest Utah HD John Charles, DE 5/4/2012 10:22